BRISTOL®
instruments

instruction manual

installation
operation
and service

ACCO | Bristol Division

PLACE THESE INSTRUCTIONS WITH THE MAN IN CHARGE OF YOUR INSTRUMENTS

IMPORTANT

- Read these instructions NOW before installing instrument.
- Keep these instructions permanently & accessibly filed for future reference.
- Be sure to specify MODEL & SERIAL numbers when ordering parts, instructions, diagrams or data.
- Ship instruments or parts for repair or exchange only to Bristol's main factory—not to Sales Offices.
- Be sure to—
  1. Identify your shipments with your exact return address & order number.
  2. Write nearest Bristol branch office giving your order number, directions & address for return shipment, full instructions for repair, etc.
- Report damage to shipments at once to shipping company. The **customer assumes responsibility for collecting any claim for damages** from the shipping company, on all shipments made on a collect basis.

FOR LOW COST MAINTENANCE OF YOUR INSTRUMENTS

Completely trained and fully equipped, Bristol Service Engineers will serve you at far less than the cost of maintaining your own staff of instrument specialists.
Experts in their jobs, these engineers provide you with instrument maintenance and repair service. Yet the training and administrative expenses normally associated with these functions are eliminated. To learn more of how these factory trained engineers can save you time, money and trouble contact your nearest Bristol Branch Office or the Bristol Division, Waterbury, Connecticut 06720.

THESE INSTRUCTIONS DO NOT PURPORT TO COVER ALL DETAILS OR VARIATIONS IN EQUIPMENT NOR TO PROVIDE FOR EVERY POSSIBLE CONTINGENCY TO BE MET IN CONNECTION WITH INSTALLATION, OPERATION OR MAINTENANCE. SHOULD FURTHER INFORMATION BE DESIRED OR SHOULD PARTICULAR PROBLEMS ARISE WHICH ARE NOT COVERED SUFFICIENTLY FOR THE PURCHASER'S PURPOSES, THE MATTER SHOULD BE REFERRED TO THE BRISTOL DIVISION OF ACCO, WATERBURY, CONNECTICUT 06720. AS A MEASUREMENT, CONTROL OR PROTECTION DEVICE OR SYSTEM, CUSTOMER SHOULD NOTE THAT A FAILURE OF THIS INSTRUMENT OR SYSTEM FOR WHATEVER REASON, MAY LEAVE THE MONITORED PROCESS UNPROTECTED. IT IS SUGGESTED THAT THE CUSTOMER REVIEW THE NEED FOR FURTHER REDUNDANT OR OTHER ALTERNATE MEANS OF PROTECTION.

INSTRUCTION NO. 65A 20384

0.4 SECOND DYNAMASTER WIDE-STRIP RECORDER

WITH COMBINATION BALANCING MOTOR-FEEDBACK GENERATOR

FOR SERIAL NO. 65A 20384 CUST. ORDER NO. _____

ITEM	DESCRIPTION	NUMBER
1	Installation, Operation and Service of Dynamaster	P12052-B
2	Service Instructions for Type D Amplifier	P12074
3	Parts List for Dynamaster	P12055-A
4	Parts List for Amplifier	P12077
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11		
12		
13		
14		
15		
	PLUS FOLLOWING ITEMS AS REQUIRED	
	INSTRUCTIONS	
	WIRING DIAGRAMS	
		019968
		013653-A
		015058
		018673

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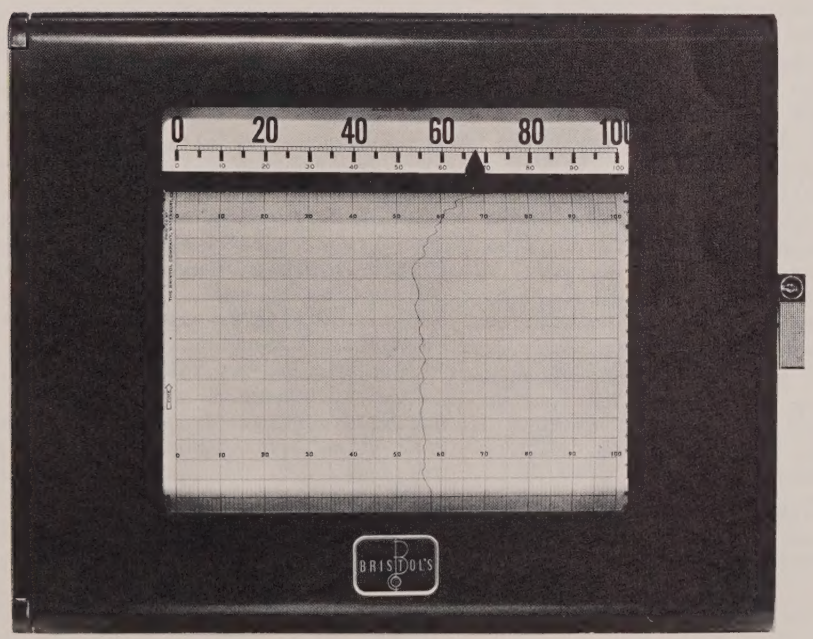
Instruction P12052-B
Issue of 9/62

INSTRUCTION NO. P12052-B

INSTALLATION, OPERATION AND SERVICE BRISTOL'S® MODEL 560 & 570 (0.4 SEC) HIGH-SPEED DYNAMASTER POTENTIOMETER AND D-C BRIDGE

WITH SPDT SYNCROVERTER SWITCH, REFERENCE VOLTAGE SOURCE, AND COMBINATION MOTOR-FEEDBACK GENERATOR



THE BRISTOL COMPANY WATERBURY 20, CONN.

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Note: This instruction covers the installation, operation and service of Bristol's High-Speed Dynamaster Potentiometer and D-C Bridge. See separate instructions on the measuring element, controls, alarms and servicing of the amplifier.

PART I GENERAL

A. Description

The High-Speed Dynamaster Potentiometer is used with any millivoltage input such as that from thermocouples, photoelectric cells, shunts, magnetos, pH amplifiers, etc.

The Dynamaster d-c bridge is used with a very low range resistance type of measuring element, such as resistance-thermometer bulbs, strain gauges, etc.

A single variable is accurately measured and recorded as a line record on the chart of the single-point recorder.

The major components of the instrument are:

1. Potentiometer circuit or bridge circuit
2. Syncroverter switch
3. Input transformer
4. Amplifier
4. Output transformer
6. Balancing motor and feedback generator
7. Recording system
8. Feedback unit

B. Explanation of Operation

1. The Dynamaster D-C Potentiometer. (See Figure 2) A millivoltage input from the measuring element is connected in series with the potentiometer circuit and Syncroverter switch. There is a standard voltage in the potentiometer circuit which is automatically adjusted to balance any change in the millivoltage input. Any change in the measuring-element voltage creates a d-c voltage unbalance in the potentiometer circuit. This d-c voltage unbalance is converted to an a-c voltage unbalance by the Syncroverter switch. The Syncroverter a-c unbalance output voltage is then increased by an input transformer before being amplified by the electronic amplifier to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slidewire to restore electrical balance in the potentiometer circuit and simultaneously moves the indicating pointer and pen to indicate and record, on the scale and chart, the value of the variable being measured.

This balancing action starts with the slightest change in the output voltage of the measuring element. Thus, recording and indicating of the measured quantity are practically instantaneous.

When balance has been restored, the entire potentiometer remains at rest until another change in the measured variable occurs.

2. The Dynamaster D-C Bridge. (See Figure 3) The measuring element forms one leg of the d-c bridge. A d-c power pack supplies 7 to 9 volts d-c to the bridge circuit. When the resistance of the measuring element changes, current flows in the bridge and a d-c voltage unbalance is created in the bridge circuit. This d-c voltage unbalance is converted to an a-c voltage unbalance by the Syncroverter switch. The Syncroverter a-c unbalance output voltage is then increased by an input transformer before being amplified by the electronic amplifier to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slide wire to restore electrical balance in the bridge circuit and simultaneously moves the indicating pointer and pen to indicate and record, on the scale and chart, the value of the variable being measured.

This balancing action starts with the slightest change in the resistance of the measuring element. Thus, recording and indicating of the measured quantity are practically instantaneous.

When balance has been restored, the entire bridge remains at rest until another change in the measured variable occurs.

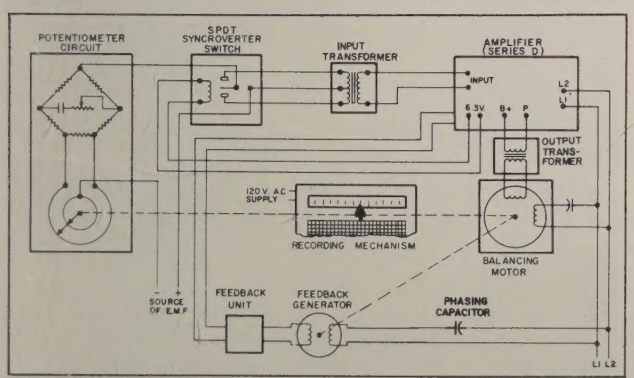

FIGURE 2. SIMPLIFIED SCHEMATIC WIRING OF HIGH-SPEED DYNAMASTER POTENTIOMETER.

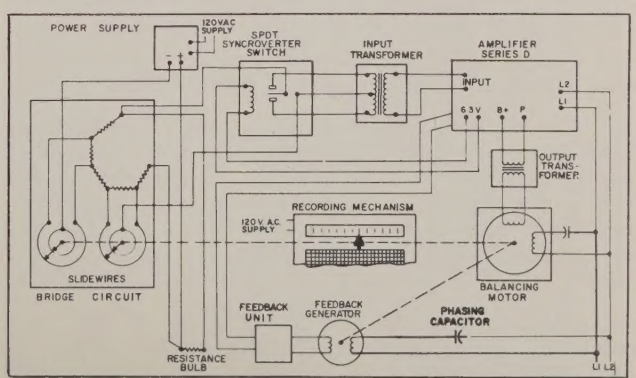

FIGURE 3. SIMPLIFIED SCHEMATIC WIRING OF HIGH-SPEED DYNAMASTER D-C BRIDGE.

3. Feedback Generator and Feedback Unit. In order to provide the necessary damping for this type of instrument, a Barber-Colman shaded-pole feedback generator is used. This generator is wired as a two-phase induction generator and is mechanically coupled to the balancing motor. The output of the generator feeds thru a feedback unit to the grid of the third stage of the amplifier thru a recepticle. This output is an a-c (line frequency) signal proportional in magnitude to the speed of the balancing motor, and its phase is dependent upon the direction of rotation of the balancing motor.

PART II INSTALLATION

A. Unpacking the Instrument

Do not throw away the packing material until you have found the mounting brackets and screws as shown in the mounting-dimension drawing, and the other accessories, such as ink, charts, spare parts, etc.

B. Locating and Mounting the Instrument

The Dynamaster may be surface mounted or flush panel mounted. Although the instrument is exceptionally free from the effects of dust, dirt, vibration, corrosive fumes and extremes of temperature, it should be located as remotely as possible from such unfavorable conditions. The location should also be convenient for service and general utility.

The instrument should be reasonably level. Proper clearance should be allowed between the Dynamaster and other instruments on the wall or panel, and clearance must be given at the bottom of the case for the wiring or piping connections.

C. External Wiring and Piping

Before connecting any wiring to the Dynamaster, check the voltage and frequency listed on the nameplate of the instrument. To connect the Dynamaster to any voltage other than 120 volts, a suitable transformer must be used. All wiring connections are made on the terminal strips mounted inside on the back of the case. The terminals are readily accessible by opening the door of the Dynamaster and swinging the panel out after first depressing its latch.

The instrument is provided with four holes in the bottom of the case to accomodate standard conduit fittings. Two of the holes accommodate 1 1/4" conduit connections and the other two accommodate 3/4" conduit connections. Conduit should be used whenever possible to bring all electrical circuits into the case. If conduit is not used, the rubber grommets supplied with the instrument should be used by punching a small hole in the center of the grommet.

The wiring diagrams for your particular Dynamaster are provided separately. The measuring circuit is usually covered on one sheet and the power circuit on another sheet. If your instrument is equipped with an electric control or alarm, a third diagram will be furnished covering its wiring.

When connecting the power line to the instrument, make sure that the grounded side of the line is connected to the right-hand power terminal. (L_1 is hot side, and L_2 is grounded side of line).

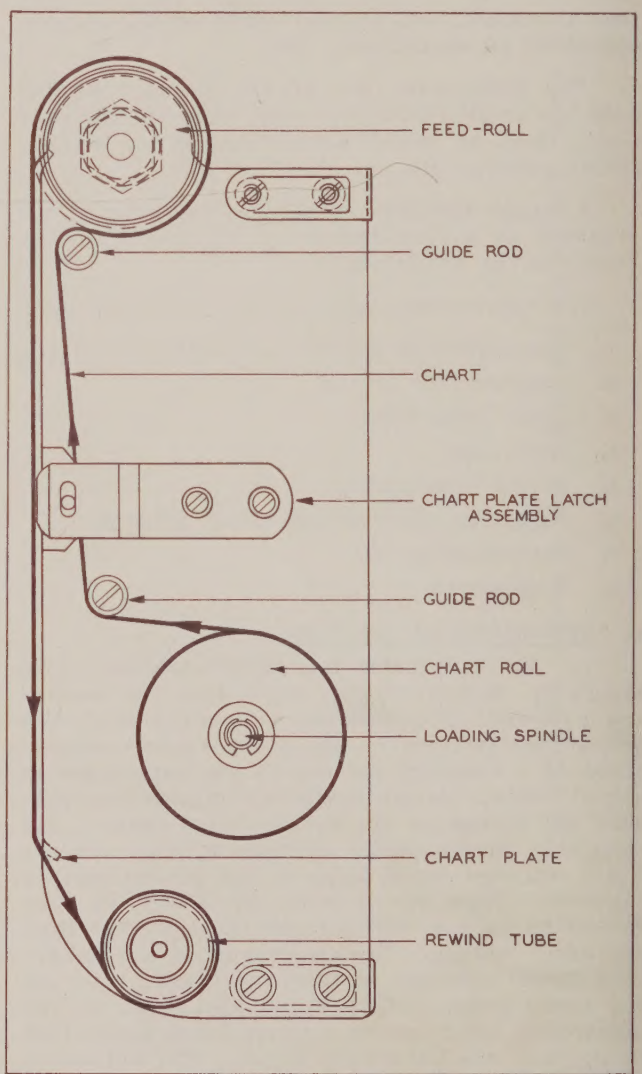

FIGURE 4. CHART INSTALLATION DRAWING.

A good ground must be connected to the terminal marked GND.

Note: Do not install measuring circuits such as thermocouple wires in the same conduit with higher-voltage lines.

Piping or tubing will be required if a pneumatic control is supplied in the instrument. Air-control instruments are provided with case connections in the bottom of the case for standard 1/4" pipe or 3/8" copper tubing.

D. Installing the Chart

A new chart roll must be flush with the left end of its tube. Before installing the chart, tap the left end (end with the round holes) on a flat surface to make sure that the tube and chart are flush. Release the chart-plate latch and swing out the chart plate. Fit the new chart roll onto the loading spindles (Fig. 4) with the round feed holes on the left. Thread the chart over the guide rods and under and around the feed roll. Latch the chart plate and attach the free end of the chart to the rewind tube with the clip provided. Take about 1 1/2 turns around the rewind tube and fit the tube onto the rewind spindles so that the key on the right rewind spindle fits into the slot in the tube. Tighten the chart by turning the rewind-spindle knob counterclockwise.

E. Installing Ball-point Pens

Ball-point pens use a special mounting bracket as shown in figure 5. To replace a ball-point pen, remove the cartridge end from the hole in the bracket and unscrew the pen end. Screw in the new pen and place cartridge end in bracket hole as shown in figure 5.

A ball-point pen should exert a force of approximately 15 grams on the chart paper for optimum recording results with a wide range of writing velocities. The mounting bracket design for this attachment assures the correct angle and pressure for this pen. The pen mounts perpendicular to the chart paper. The ink supply must always be above the ball-point, and the bending radius of the cartridge should not be less than 1/2 inch.

Ball-point pens are available in the following ink colors: Red, part #A8253; Blue, A8254; Green, A8255; and Black, A8256.

F. Filling and Starting Fountain Pen

Note: See Paragraph G for instruments equipped with capillary type pen feed.

Remove filler cap from pen and fill reservoir with ink. Before replacing filler cap, suck ink thru pen by using pen starter provided. After starting pen, replace filler cap.

The fountain pen is factory adjusted to provide a minimum amount of end shake. A screw adjustment on the right side of pen holder is provided for making any readjustment. The pen should be just free enough to fall of its own weight in its bearings. The retaining spring tension should be removed from pen during this check. Too much play will produce inaccurate chart readings.

G. Filling and Starting Capillary Type Pen Feed

Note: For instructions on capillary pen with replaceable vented tip, see Instructions P12159-2.

The capillary pen has a metal pen connected by capillary tubing to an ink reservoir located on the back of the hinged panel (see figures 7 and 8).

Remove reservoir cap and fill reservoir with ink. Replace reservoir cap making sure that a portion of the capillary tubing lies on the bottom of the reservoir. The ink level should not exceed the height of the pen nib.

The height of the reservoir may be changed to increase or decrease the weight of the pen record by simply loosening the nut holding the reservoir mounting bracket and sliding the assembly up or down slightly as required. Be sure to retighten nut firmly after any adjustment.

Start the pen by placing pen in the hole on the stem of the pen starter. Squeeze the bulb of pen starter. Release bulb and allow the starter to suck the ink from the reservoir thru the pen. Pen may also be started by applying

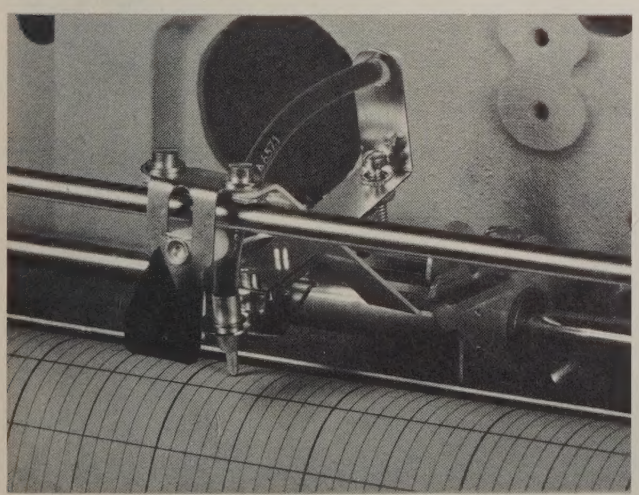

FIGURE 5. BALL POINT PEN.

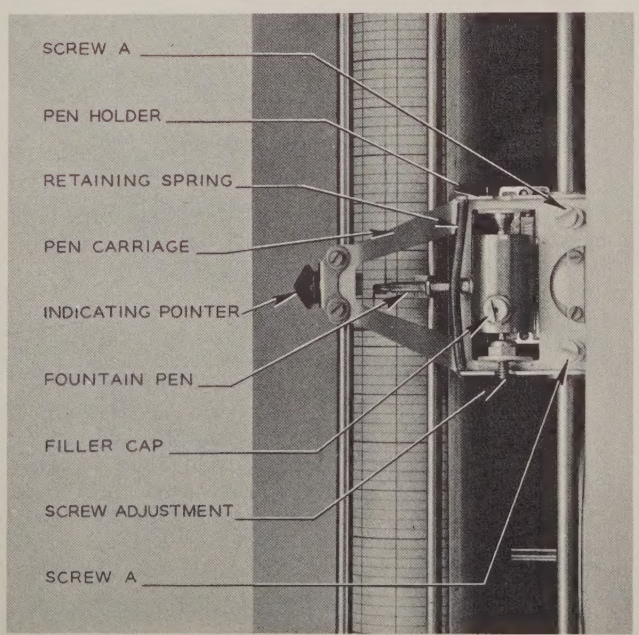

FIGURE 6. INSTALLATION OF FOUNTAIN PEN.

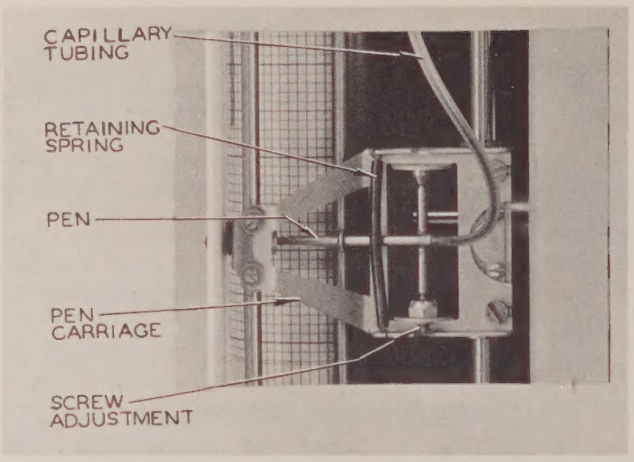

FIGURE 7. CAPILLARY PEN.

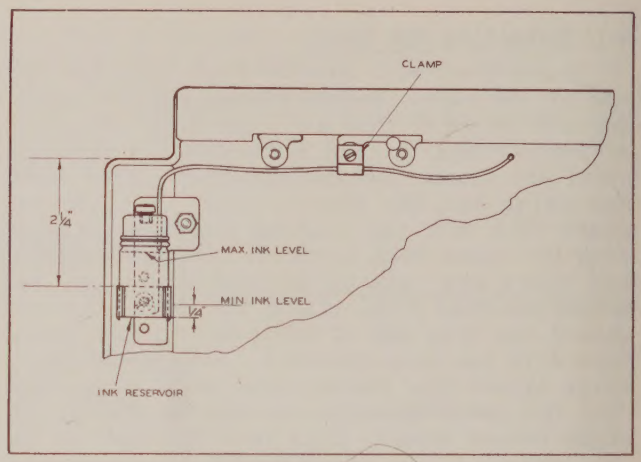

FIGURE 8. LOCATION OF INK RESERVOIR FOR CAPILLARY PEN (REAR OF HINGED PANEL).

pressure at the vent hole in the reservoir cap by means of the bulb end of the starter.

Refill reservoir whenever ink level drops to within 1/4" of the bottom. Occasionally remove reservoir and wash out with warm water.

The pen is factory adjusted to provide a minimum amount of end shake. A screw adjustment on the right side of the pen holder is provided for making any adjustment. The pen should be just free enough to fall of its own weight in its bearings. The retaining spring tension should be removed from pen during this check. Too much play will produce inaccurate chart readings.

PART III OPERATION

A. Amplifier Gain Adjustment

The amplifier gain adjustment should be checked after the instrument is first installed and once every 3 or 4 months thereafter. While this check is being made, the measured variable should be at a steady value.

To check amplifier gain, proceed as follows:

1. The measured variable should be kept at a steady value or the input signal should be replaced with a d-c test signal source such as that from a Bristol Dynaprobe.

2. Turn on the instrument and allow amplifier to warm up for at least 10 minutes.

3. Remove cap from damping adjustment (located on top of feedback unit) and turn adjusting screw to its minimum counterclockwise position.

With the damping adjustment in this position, the pen may tend to overshoot each time the balancing motor is shifted off balance.

4. Turn bull gear manually (about 1% of scale range) in one direction and then release it. Note position of pen. Then turn bull gear in the opposite direction (about 1% of scale range) and release it. Adjust the gain until the pen returns to within 0.1% of the same position after an unbalance in each direction.

To increase gain, turn gain adjusting screw in a clockwise direction.

There is an optimum position for the gain adjustment. If the gain is too low, the pen will not return quickly to its proper value when the balancing motor is manually shifted off balance. If the gain is too high, the pen may "hunt".

When the gain adjustment has reached its maximum clockwise direction, the amplifier lacks sensitivity and requires new tubes.

After replacing tubes, always recheck the gain adjustment.

B. Generator Residual Adjustment

This adjustment is made at the factory and should only require readjustment when a feedback generator is replaced. When readjustment is necessary, the following procedure should be followed:

1. Turn instrument on and allow a 10 minute warm up period.

2. Remove first 7F7 tube (V_1 in figure 15).

3. Turn damping adjustment (located on top of feedback unit) to maximum clockwise position.

4. Adjust generator residual adjustment so that instrument does not drive pen either up or downscale.

5. Return damping adjustment to minimum counterclockwise position.

6. Replace 7F7 tube.

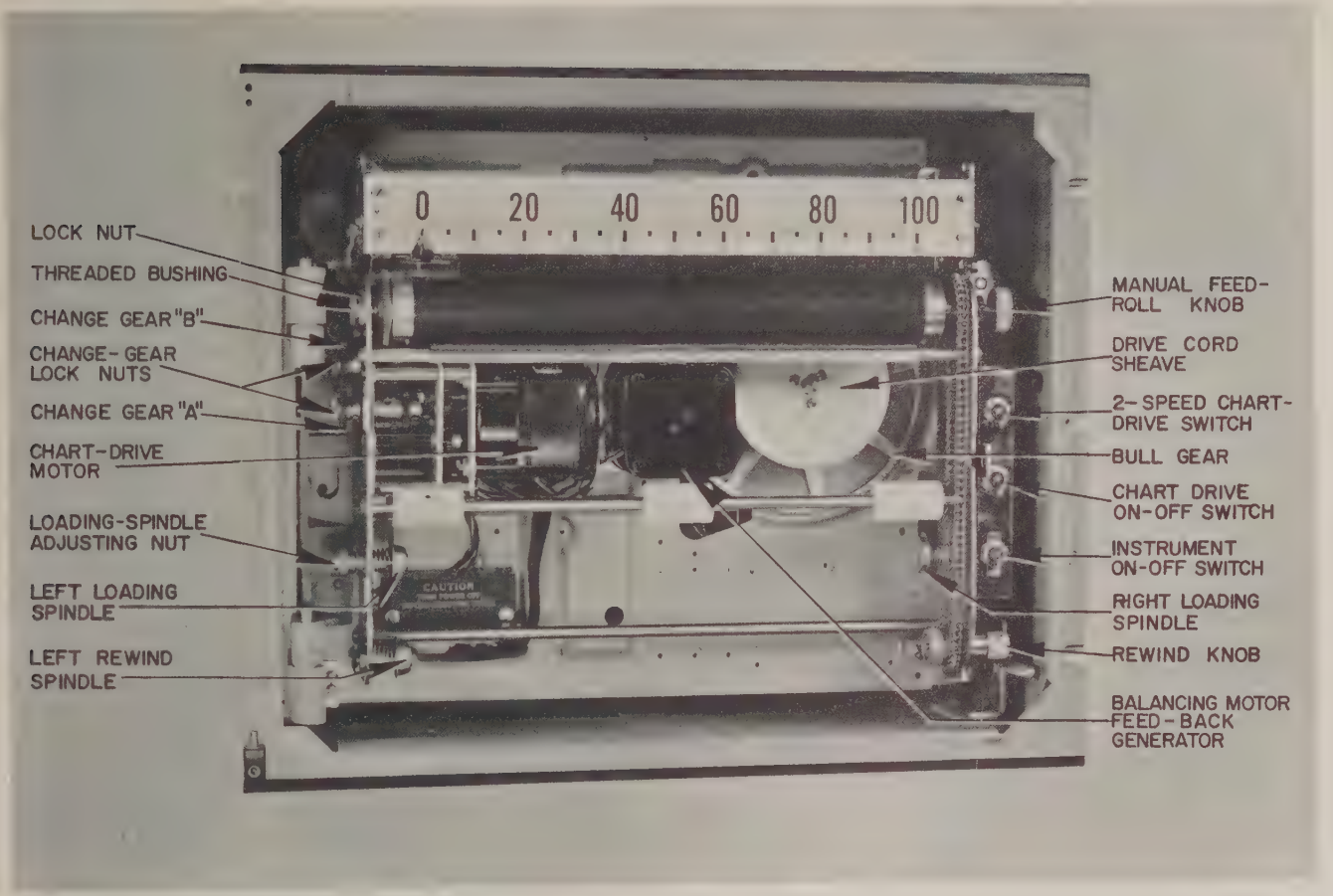

FIGURE 9. FRONT OF HINGED PANEL

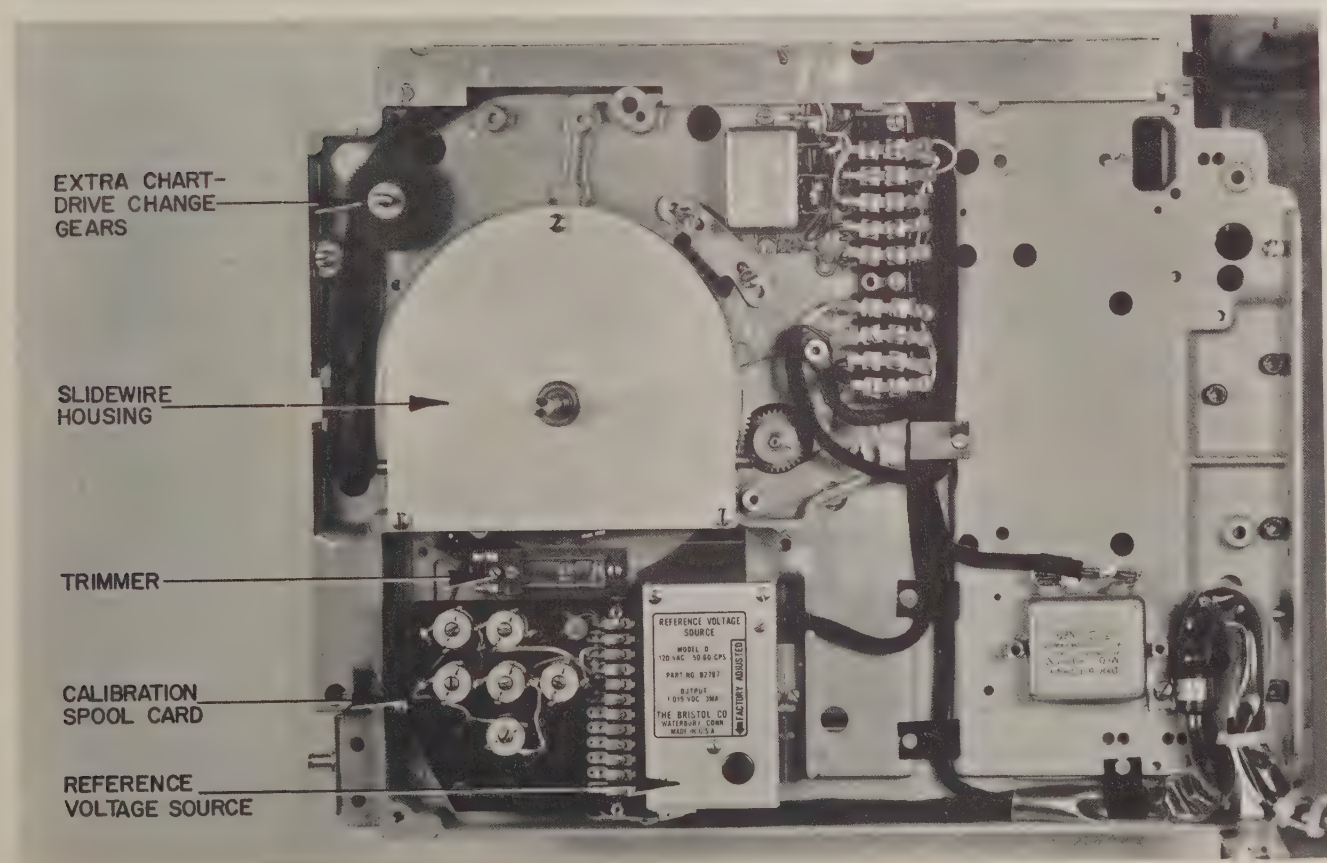

FIGURE 10. REAR OF HINGED PANEL

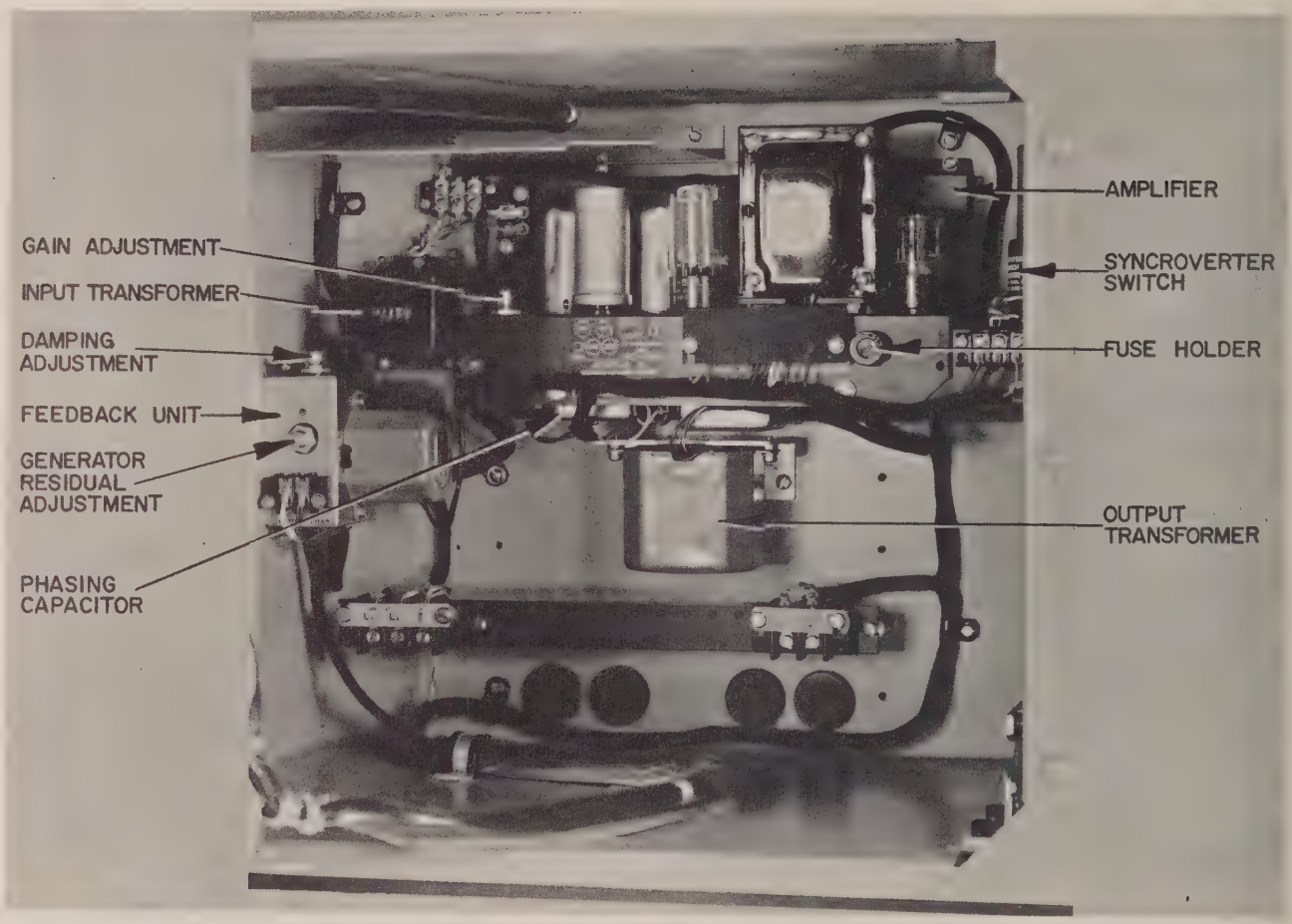

FIGURE 11. INTERIOR OF CASE.

C. Damping Adjustment

The damping adjustment is located on the top of the feedback unit (see figure 11).

Method #1

For instruments with or without an R-C filter, the damping may be adjusted as follows:

After making the gain adjustment as prescribed in paragraph A above, apply a step-signal voltage* across the input terminals and note the response. Adjust damping for desired response.

Method #2

If the instrument is supplied without an R-C filter and a d-c step-signal voltage is not available, the damping may be adjusted as follows:

After making the gain adjustment as prescribed in paragraph A above, offset the pen from balance about 5% of the scale range by manually turning bull gear and then releasing it. Note dynamic response. By adjusting the damping, the desired characteristics can be obtained. In most applications, this is usually a square response. To increase damping, turn damping adjustment screw in a clockwise direction.

*If the instrument is supplied with an R-C filter, apply approximately a full scale step signal and adjust the damping for this response. If no filter is supplied, damping should be adjusted with a step input signal of approximately 10%.

D. Chart-Drive Switch and Pen-Lifter Relay

High-speed instruments are usually ordered with a chart-drive switch and pen-lifter relay. The pen-lifter relay is wired in parallel with the chart drive. When the chart-drive switch is turned on, the chart will move and the pen will make contact with the paper. When the chart-drive switch is turned off, the chart will stop and the pen will be lifted off the paper.

Separate terminals are provided for remote operation of chart drive and pen-lifter relay when so ordered.

PART IV SERVICE

A. Care of Fountain Pen

The pen should be kept at least a quarter full of ink. If it clogs or draws a poor record, clean it with the wire pen cleaner provided. If necessary, wash the pen with soap and warm water.

B. Lining up the Chart

It is extremely important that the chart be correctly lined up. This is done very carefully at The Bristol Factory and should seldom need adjustment. However, if the left-hand guide pins on the feed roll should tear or distort the holes in the chart, the chart must be realigned as follows:

If the chart tends to tear on the left side of the holes, loosen setscrew in loading-spindle adjusting nut and turn adjusting nut in a clockwise direction until chart feeds properly. While making this adjustment, hold onto the collar located to the left of and on the same shaft as the adjusting nut. This prevents the shaft from turning while the adjusting nut is being turned.

If the chart tends to tear on the right side of the holes, turn adjusting nut in a counterclockwise direction until chart feeds properly.

If the chart tends to tear on the back side of the holes, the rewind-spindle clutch is too tight. To loosen clutch, turn rewind-spindle clutch plate counterclockwise (see figure 9). There are 2 holes in this plate into which any small metal object (such as a nail or paper clip) can be inserted to turn it. (See Par. D).

C. Setting the Mechanical Zero

All Bristol Dynamaster Wide-Strip Recorders shipped after December 15, 1953 will be adjusted to have a live zero. The mechanical stop on these instruments will be set so that the pen is mechanically stopped at a point .035" below the live zero. This mechanical stop is referred to as the stop bracket in figure 10.

As rapidly as possible, all wide-strip charts will be reprinted with a dotted line .035" below the live zero to indicate the position of the mechanical stop.

On older instruments not already adjusted to a live zero, the following procedure should be followed in resetting the mechanical zero to the new charts.

Turn off instrument. Rotate the large drive gear until stop pin hits the low side of stop bracket. If pen is not on the dotted line, loosen screws holding stop bracket and shift bracket sufficiently to permit pen to be moved to rest on the dotted line. Then retighten screws holding stop bracket.

When it is necessary to install a new pen or drive cord, or whenever the setting of the pen carriage has been disturbed, the following procedure should be followed:

1. Turn off instrument.
2. Rotate the large drive gear until stop pin hits the low side of stop bracket.
3. Set pen on dotted line below the live zero, by loosening drive-cord clamp on top of pen carriage and slide pen carriage until pen is on the dotted line.
4. Tighten drive-cord clamp and turn on instrument.

D. Adjusting the Rewind-spindle Clutch

If the chart rewind tube slips or rewinds loosely when the Dynamaster is operating, tighten the rewind-spindle clutch (figure 9) by turning the rewind-spindle clutch plate clockwise. There are 2 holes in this plate into which any small metal object (such as a nail or paper clip) can be inserted to turn it.

E. Adjusting the Feed-roll Clutch

The feed-roll clutch has been carefully installed at the Bristol factory and generally never requires adjustment. Under unusual operating conditions, however, it may lose its friction. If it does not feed the chart smoothly at the correct rate, inspect the feed-roll clutch (figure 12) for slippage. By removing the rewind roll and turning the feed-roll knob, the clutch tension can be felt. The feed roll should **not** turn freely. If it does, the clutch is probably slipping.

To tighten the clutch, the entire feed roll must be removed. Take off the feed-roll knob and unscrew the setscrew in the feed-roll sprocket so that the sprocket turns freely. Remove both threaded bushings with their lock nuts, being careful not to lose the bearings. Move the left end of the feed roll out beyond the chart-assembly bracket and withdraw it from the drive sprocket. Push the feed-roll drive shaft through the feed roll until the clutch-spring adjusting nut is accessible. Tighten the adjusting nut until the clutch tension is sufficient to feed the chart correctly.

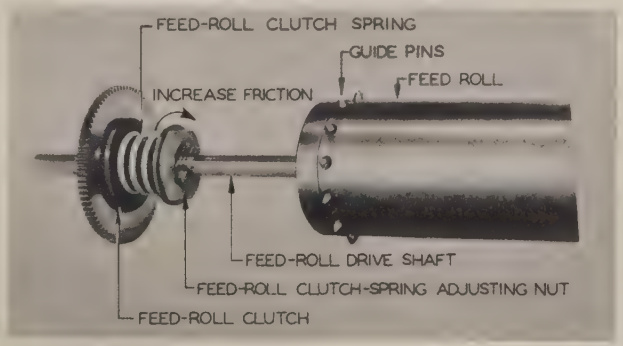

FIGURE 12. FEED-ROLL CLUTCH.

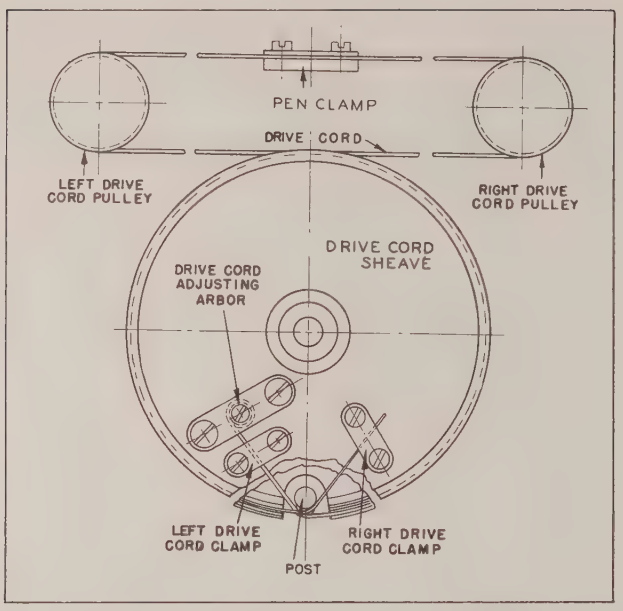

FIGURE 13. DRIVE CORD INSTALLATION DRAWING.

F. Replacing or Adjusting the Pen Drive Cord

To replace a broken or worn cord, loosen the drive-cord clamps on the drive-cord sheave, loosen the drive-cord clamp on the pen assembly and take out the old cord (figure 13). Turn the drive-cord sheave so that the clamps are at the bottom. Thread one end of the new cord under the left drive-cord clamp and thru the adjusting arbor. Tighten the clamp. Thread the cord around the post and the right-hand side of the sheave (in the rear groove), around the left drive-cord pulley, thru the hole in the left-hand scale bracket, thru the hole in the right-hand scale bracket, around the right drive-cord pulley, around the left-hand side of the sheave (in the front groove), around the post, thru the right drive-cord clamp on the sheave. Tighten the clamp. Make sure that the cord is on all the pulleys, then turn the adjusting screw clockwise to tighten the cord to the proper tension. It should be tight enough to prevent backlash but not so tight as to cause the drive-cord pulleys to bind. Tighten the left drive-cord clamp and clip off any excess cord which may remain beyond the arbor.

Now clamp the pen assembly to the cord. Be sure that the pen is correctly zeroed by turning the main drive gear by hand until it hits the low stop. Center the pen exactly on the lowest division of the chart (usually zero) and clamp the drive cord securely. (See Par. C).

G. Changing Chart Speeds

To change the chart speed on a Bristol Wide-Strip Dynamaster, first remove the change-gear lock nuts and the change gears from their shafts. (See figure 9).

Find the chart-drive motor behind the chart plate and determine the make and speed of the motor from its nameplate. The nameplate is

LOW-SPEED GEAR TRAIN				HIGH-SPEED GEAR TRAIN			Gear Position	Pitch	Number of Teeth	Part Number	Identification
2 rpm Telechron Motor	4 rpm Telechron Motor	10 rpm Holtzer-Cabot Motor	60 rpm Holtzer-Cabot Motor	4 rpm Holtzer-Cabot Motor	10 rpm Holtzer-Cabot Motor	60 rpm Holtzer-Cabot Motor					
Chart Speed (inches/hour)			Chart Speed (inches/minute)			Chart Speed (inches/second)					
3/4	1 1/2	3 3/4	3/8	1	2 1/2	1/4	1 2	40 40	16 64	92105 92103	C H
1	2	5	1/2	1 1/3	3 1/3	1/3	1 2	48 48	24 72	79225 79223	J N
1 1/2	3	7 1/2	3/4	2	5	1/2	1 2	48 48	32 64	79218 79222	K M
2	4	10	1	2 2/3	6 2/3	2/3	1 2	40 40	32 48	79227 79221	E F
3	6	15	1 1/2	4	10	1	1 2	48 48	48 48	79224 79224	L L
4 1/2	9	22 1/2	2 1/4	6	15	1 1/2	1 2	40 40	48 32	79221 79227	F E
5	10	25	2 1/2	6 2/3	16 2/3	1 2/3	1 2	40 40	50 30	94210 94212	G D
6	12	30	3	8	20	2	1 2	48 48	64 32	79222 79218	M K
9	18	45	4 1/2	12	30	3*	1 2	48 48	72 24	79223 79225	N J
10	20	50	5	13 1/3	33 1/3	3 1/3*	1 2	32 32	50 15	94214 94216	B A
12	24	60	6	16	40	4*	1 2	40 40	64 16	92103 92105	H C

*60 cycle only

FIGURE 14. TABLE OF CHANGE GEARS FOR CHART DRIVE.

located on the end of Telechron motors and on the top of Holtzer Cabot motors.

Find the column for the particular motor you have in the table figure 14. Read down that column to find the desired chart speed; then read across the table to the right to find the gear train required.

The number of teeth and the pitch should be marked on all gears with 32 or more teeth. If two gears with the same number of teeth are not marked for pitch, the smaller one is 48 pitch.

Put the gears on their respective shafts, making sure the "A" gear goes on the lower shaft. Be sure the slots in the gears engage the keys on the hubs so that they will not slip. Lock them in place with the change-gear lock nuts.

Note: If there does not appear to be enough gears for all the desired chart speeds, remember that each set of gears will give two speeds, depending on which gear is used as the "A" gear.

Spare chart-drive change gears are mounted on a stud located on the back of the hinged panel (upper left corner).

H. Suggested Service Equipment

1. Stock of Replacement Parts. It is suggested that the following replacement parts be kept in stock. The vacuum tubes listed below are standard types and are available at any radio supply store:

Type 6AX5 rectifier tube

Type 5881 power amplifier tube

Type 7F7 voltage amplifier tube

Plug-in-type electrolytic filter capacitor with octal base (10-10-10 mfd. 450 volt)
Note: Electrolytic capacitors deteriorate in storage. Their shelf life should not be over 18 months. Replacement electrolytic capacitors can be kept in usable condition indefinitely by placing them in service in the Dynamaster for an hour or two every six months.

Fuses for amplifier (1/8-ampere Littlefuse for series D amplifier).

Amplifier. Where several Dynamasters are in use or where continuous instrument performance is of critical importance, it is recommended that spare replacement amplifiers be kept in stock.

2. Test Equipment

A signal generator, such as Bristol's Dynaprobe Part No. C1038, is highly recommended because it provides a quick means for isolating trouble in the detection circuit of the Dynamaster without having to remove the Dynamaster from service or disconnecting the input circuit or the power to the instrument.

An **a-c voltmeter** or **test lamp** is required to perform the power-supply check.

An **ohmmeter** is convenient when checking the continuity of the measuring system.

On potentiometer-type instruments, a **potentiometric test set** is required (one with ranges 0 to 150 millivolts and 0 to 1.5 volts).

On d-c bridge-type instruments, a set of **test resistance spools** is handy for checking resistance measuring instruments. The Bristol Company manufacturers a set of very accurate resistance spools. Spools may be ordered by the set or singly for any value. Ordinary variations in room temperature do not affect their accuracy.

J. Systematic Trouble-shooting Procedure

Should the Dynamaster fail in any way, it is first necessary to determine which part is faulty. The following systematic procedure is suggested in order that repairs may be accomplished with a minimum of lost time and expense.

1. Power-supply Check. Using a 150-volt-range a-c voltmeter (or test lamp) check for line voltage across instrument power terminals, instrument power switch, L_1 and L_2 terminals on back of swinging panel, and also L_1 and L_2 terminals on amplifier.

2. Balancing-motor Check

Caution: Always be sure to turn power switch off before shifting the two control-winding wires because of the high voltage (300 volts) across terminals M_1 and M_2.

a. On instruments with the Series D amplifier. Turn power switch off. Remove the two control-winding wires at terminals M_1 and M_2 (figure 10) and then put these wires across terminals L_1 and L_2 on the same terminal block. Turn on power switch. The motor should move the pen up or downscale (depending upon phase). Next, reverse these wires from the control winding. The motor should move the pen in the opposite direction. If the balancing motor fails to move the pen up or downscale with the above tests, it could mean that one of the following conditions exists:

1. No power to balancing motor.
2. Balancing motor defective.
3. Mechanical failure between balancing-motor pinion, bull gear and recording-pen shaft.

3. The Amplifier. Connect Dynaprobe to 120 volt, 60 cycle supply terminals of instrument. Set toggle switch to "a-c" position. Apply test prongs across the input terminals of the amplifier (see figure 15). If amplifier is working properly, the balancing motor will move the pen up or downscale (depending upon phase). Reversing the two test prongs will cause the balancing motor to move the pen in the opposite direction. If the balancing motor does not move the pen up or downscale, disconnect the input leads to amplifier and check again with the test prongs across input terminals to amplifier. If the

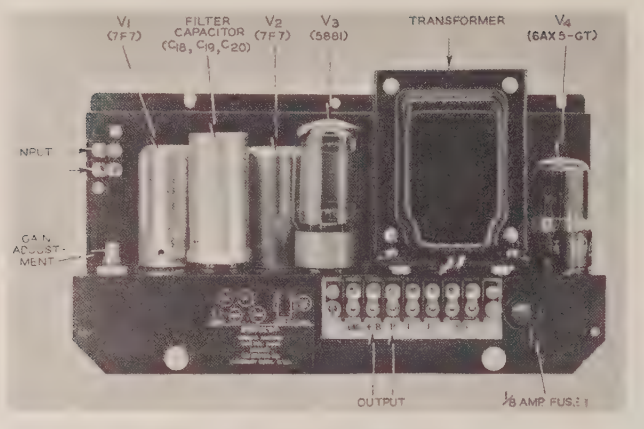

FIGURE 15. SERIES D AMPLIFIER.

balancing motor still does not move the pen up or downscale, check fuse in amplifier, replace vacuum tubes and filter capacitor in amplifier. If this does not work, replace the amplifier.

Note: Amplifier tubes will still be lit even after fuse is blown.

Note: The Bristol Company recommends that service work inside the amplifier chassis should not be attempted by the average user. Service work on electronic circuits is a specialized technique requiring special test equipment for efficient results. For users having available an electronic technician and adequate test facilities, The Bristol Company has prepared service instructions for the amplifier which contain a detailed circuit diagram, testing data and procedure for checking the amplifier. A copy of this instruction is furnished with each Dynamaster.

4. Input Transformer. Apply test prongs from Dynaprobe to input terminals of input transformer (pink and yellow wires). If input transformer is O.K., the balancing motor will move the pen up or downscale (depending upon phase). Reversing the test prongs will cause the balancing motor to move the pen in the opposite direction. If the balancing motor does not move the pen up or downscale, disconnect the input leads to transformer and check again with the test prongs across input terminals to transformer. If pen still does not move up or downscale with this test, the input transformer is defective and should be replaced.

5. Syncroverter® Switch. With toggle switch on Dynaprobe depressed to provide a d-c signal, apply test prongs to input terminals of Syncroverter switch (orange and brown wires). If Syncroverter switch is functioning correctly, the balancing motor will move the pen up or downscale (depending upon phase). Reversing the test prongs will cause the balancing motor to move the pen in the opposite direction. If the balancing motor does not move the pen up or downscale, disconnect the orange and brown wires from Syncroverter switch and check again with the test generator. If the balancing motor still does not move the pen up or downscale with this test, the Syncroverter switch is defective and should be replaced.

If steps 1 thru 5 have been performed and all of the components function correctly but the instrument still fails to function, the fault probably lies in the measuring system of the instrument.

6. Feedback Generator and Feedback Unit. In order to provide the necessary damping for this type of instrument, a drag cup generator is used in the feedback circuit. This generator is mechanically coupled to the balancing motor. The output of the generator feeds thru a feedback unit to the grid of the third stage of the amplifier thru a receptacle. This output is a 60 cycle a-c signal, proportional in magnitude to the speed of the balancing motor, and its phase is dependent upon the direction of rotation of the balancing motor.

If the feedback components are believed to be defective, the following tests will isolate the cause:

a. Check V_2 and V_3 for low gain. If damping is still not adequate, check the feedback generator as outlined in the following steps.

b. Turn instrument power switch off.

c. Remove V_1 tube from amplifier.

d. Remove yellow wire from left-hand terminal K on back of hinged panel.

e. Connect voltmeter (12 V. a-c range) across generator output terminals (orange and yellow leads on terminal block).

f. Turn instrument power switch on. Move pen carriage back and forth at a rate of about .5 seconds for one sweep across the chart. This will in turn rotate the generator shaft and therefore produce an output voltage proportional to speed, which can be detected on the voltmeter. At the rate of .5 seconds for one sweep across the chart (either direction) the voltage should be approximately 3.5 to 4 volts a.c.

If low output or no output can be detected, check the voltage across the generator excitation terminals C2 and L2. The voltage should be about 65 volts. If voltage is low, check phasing capacitor.

If generator checks O.K., replace the feedback unit mounted on the side of the case to the left of the amplifier.

7. Measuring System on Potentiometers. The potentiometer type of Dynamaster uses the null-balance potentiometer circuit. From the simplified schematic wiring diagram (figure 2) it will be noted that the measuring element is wired in series with the potentiometer circuit, Syncroverter contacts and primary winding of the input transformer. This means that an open circuit anywhere in the measuring circuit, slide wire, Syncroverter contacts or primary winding of the input transformer will produce the same result: no error signal in the circuit and consequently no output from the amplifier to the balancing motor.

Check carefully the particular measuring element used to see that it is functioning correctly. Check particularly the wiring connections at both the measuring element and the instrument. Disconnect the measuring-element leads from the instrument and connect them to a potentiometric test set to be sure that the measuring element is producing the voltage required for the existing conditions. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Caution: Never put an ohmmeter across any part of the measuring system without first disconnecting the input leads to the Syncroverter switch. The reason for this is that the ohmmeter produces a relatively high current and would damage the Syncroverter contacts.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

Check to see that the slidewire brush arm makes good contact with the slidewire. Try cleaning slidewire with Bristol cleaning fluid Part No. A5700. Allow to dry. Then apply a small amount of vaseline to slidewire and wipe off excess with a clean cloth.

Caution: If a solvent other than Bristol cleaning fluid is used to clean slidewires, it must be a type that will not leave a residue, or one that will not attack varnish.

If all of the above checks have been performed and the instrument still fails to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

8. Measuring System on D-C Bridges. From the simplified schematic diagram (figure 3) it will be noted that the measuring element is wired so as to form one leg of the bridge. An open circuit anywhere in the bridge will produce an infinite resistance, driving the pen or print wheel to the top or bottom of the chart depending upon what portion of the bridge is open-circuited. If an open circuit is suspected, it can easily be checked with an ohmmeter. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Caution: Never put an ohmmeter across any part of the measuring system without first disconnecting the input leads to the Syncroverter switch. The reason for this is that the ohmmeter produces a relatively high current and would damage the Syncroverter contacts.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

a. Check output voltage of power pack (7 to 9 volts d-c).

b. Check to see that the slidewire brush arm makes good contact with the slidewire. Try cleaning slidewire with Bristol Cleaning fluid. Allow to dry. Then apply a small amount of vaseline to slidewire and wipe off excess with a clean cloth.

If all of the above checks have been performed and the instrument still fails to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

9. Reference Voltage Source. The Bristol Zener Diode Reference Voltage Source, used on all d-c potentiometers is an accurate d-c voltage source with a high degree of stability and reliability. It utilizes Zener diodes as the reference elements in the pre-regulating and output stages of the regulating circuit.

This unit is factory adjusted to produce 1.0190 volts across the bridge circuit. Normally, no additional adjustment should be required. If it is desired to check the output voltage, it should be done with the load of the bridge circuit disconnected at the reference voltage source output terminal block, and a load of 339.67 ohms substituted across the terminals as equivalent to the proper bridge load.

The check should be made by balancing against a potentiometric test set. If the voltage is not within tolerance, remove the black snap-in plug in the cover below the name plate and adjust the potentiometer to produce the correct output voltage. Replace snap-in plug after any adjustment.

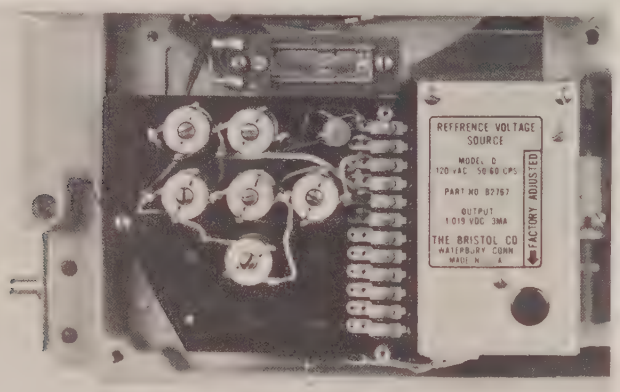

FIGURE 16. REFERENCE VOLTAGE SOURCE & PLUG-IN SPOOL CARD.

10. The Recording System. The recording system is mechanical. It includes the chart drive and its gear train, chart feed roll, pen, pen drive cord and pulleys, etc.

Check the recording system for mechanical troubles, such as loose or binding gears, pulleys and fittings, etc. Move the pen up and downscale manually by turning the main drive gear (with power off). It should move freely from one end of the scale to the other.

Feed the chart manually by turning the feed-roll knob counterclockwise. The tension of the feed-roll clutch should be felt, but the chart should feed straight and smooth without tearing or distorting the holes. The pen should make a clean, legible record.

K. Checking Calibration

To check the calibration of a potentiometer requires the use of a potentiometric test set (one with ranges 0-150 millivolts and 0 to 1.5 volts).

1. Connect potentiometer to input terminals of instrument and turn on instrument power supply. Allow a 10 minute warm up before proceeding with the next step.

2. Set test set for 10% of scale range. Check sensitivity of recorder by moving pen upscale (by manually turning balancing motor pinion)and allowing instrument to rebalance. Then move pen downscale and allow instrument to rebalance. Note the dead band. It should be between 0.1 and .05% of full scale. If dead band is greater than 0.1%, turn gain control on amplifier clockwise until dead band is correct. If dead band is less than .05%, turn gain control counterclockwise until dead band is correct.

Adjust pen and pointer to read correctly at this point. Do this by loosening the two screws on the top of the pen carriage which clamps the drive cord to the pen carriage. When pen is correct, tighten screws in clamp.

3. Next set test set at 80% of scale range. If pen or pointer reads low, loosen slider on trimmer and move slider to left until pen is correct. Tighten slider and check calibration at several more points on scale. If pen or pointer reads high, move slider on trimmer to the right.

L. Miscellaneous Trouble-shooting Tips

In general, the following symptoms of trouble described below are caused by definite faults.

For all failures not specifically described below, follow the systematic trouble-shooting procedure outlined in Paragraph J.

1. Symptoms: Pen remains stationary regardless of changes in the value of the measured variable. **Possible faults:**

a. Defective line fuses
b. Power failure
c. Defective amplifier fuse. An amplifier fuse which burns out repeatedly generally indicates a bad rectifier tube or filter capacitor (plug-in capacitor).
d. Defective tube in amplifier
e. Defective filter capacitor
f. Open circuit in measuring element
g. Syncroverter-switch failure
h. Defective balancing motor

2. Symptom: Pen records incorrect values. **Possible faults:**

a. Defective measuring element
b. Incorrect gain adjustment

Applies only to instruments without Zener diode reference voltage source.

3. Symptom: Chart does not feed properly. **Possible faults:**

a. Chart is not lined up properly
b. Feed-roll clutch is slipping

4. Symptom: Chart speed is incorrect. **Possible faults:**

a. Wrong change gears
b. Defective motor
c. Frequency of power supply incorrect

M. Repairs, Correspondence and Shipping

If the Dynamaster cannot be repaired with the information furnished in this instruction, it should be shipped to the nearest Company branch or Main Factory for repair or replacement. Do not ship instruments to Branch Offices. Be sure to mark your return address plainly.

In all correspondence please mention the instrument model and serial number (as listed on its nameplate) and your repair order number. Address all correspondence to the Bristol Company branch or Main Offices, a list of which is found in all instruction manuals.

Instruction No. P12074
Issue of May 1965

INSTRUCTION NO. P12074

SERVICE INSTRUCTIONS FOR THE SERIES D & D-3 AMPLIFIERS

PART I INTRODUCTION

This instruction covers the service of the Series D (60 cycle) and D-3 (50 cycle) amplifiers used on Bristol's High-Speed (0.4 sec.) Dynamasters.

Service work on electronic circuits is a specialized technique requiring special test equipment. Only a qualified electronic technician should attempt service inside the amplifier chassis. If a qualified technician is not available, the amplifier should be returned to the nearest Bristol Company Branch or Main Factory for repair. Adequate stocks of guaranteed, factory-rebuilt exchange amplifiers are maintained at several points throughout the country to assure fast replacement. Contact nearest Bristol office as listed on last page of all instruction books.

PART II TEST EQUIPMENT

Multirange volt-ohmmeter with ranges 0 to 50 and 0 to 500 volts d-c, 0 to 4000 and 0 to 500,000 ohms resistance, voltage sensitivity 20,000 ohms per volt.

A signal generator, such as Bristol's Dynaprobe Part No. C1038, is recommended for producing a test input signal. Figure 1 illustrates how a signal generator can be made.

Cathode-ray oscilloscope with an input impedance not less than 500,000 ohms and a vertical sensitivity of .03 volts.

PART III TEST PROCEDURE

Disconnect all leads to amplifier and remove amplifier from Dynamaster. The amplifier may be removed by loosening the rear mounting screws and unlocking the quick fasteners on the front of the chassis.

Connect a 500 ohm 10-watt resistor across the output terminals of the amplifier.

Caution: Never check an amplifier without first connecting the 500-ohm resistor across the output terminals of the amplifier.

Connect the 120-volt power supply to power terminals marked L_1 and L_2. This is the nominal operating voltage and any variation from it will produce slightly lower or higher test readings.

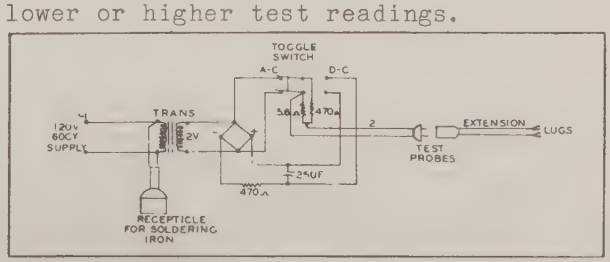

FIGURE 1. WIRING OF TEST INPUT-SIGNAL GENERATOR

Measure		Correct	Recommended Correction	
From	To	Voltage	If Voltage Is Too Low	If Voltage Is Too High
B+	Gnd.	320 ± 32	Replace V_4 & plug-in capacitor No voltage. Replace fuse.	Replace V_3
B_5	Gnd.	300 ± 30	Replace plug-in capacitor	Replace V_3
B_4	Gnd.	280 ± 28	Replace plug-in capacitor	Replace V_1 or V_2
B_3	Gnd.	225 ± 22	Replace plug-in capacitor	Replace V_1 or V_2
S_c	Gnd.	265 ± 26	Replace V_3	Replace V_3 Check R_{23}
B_{1-2}	Gnd.	190 ± 20	Replace plug-in capacitor Check C_{21}	Replace V_1
P_5	Gnd.	265 ± 26	Check voltage at B_5	Replace V_3
P_4	Gnd.	160 ± 16	Check voltage at K_4	Check R_{19}
P_3	Gnd.	120 ± 12	Check voltage at K_3	Check R_{15}
P_2	Gnd.	105 ± 10	Check voltage at K_2	Check R_7
P_1	Gnd.	105 ± 10	Check voltage at K_1	Check R_3
K_5	Gnd.	16 ± 2	Check C_{16}	Check R_{23}
K_4	Gnd.	2.4 ± 0.5	Check C_{13} & R_{19}	Check R_{18}
K_3	Gnd.	1.8 ± 0.5	Check C_{10}	Check R_{14}
K_2	Gnd.	1.7 ± 0.5	Check C_4	Check R_6
K_1	Gnd.	1.7 ± 0.5	Check C_1	Check R_2
Note: Points K_1, K_2, etc., were marked C_1, C_2, etc., on earlier models.				

FIGURE 2. TABLE OF D-C VOLTAGE CHECKS BASED ON A LINE VOLTAGE OF 117 VOLTS AND A 500-OHM 10 WATT RESISTOR ACROSS THE OUTPUT TERMINALS OF AMPLIFIER

Warning: There are dangerous voltages in the amplifier. Never touch any part with bare hands unless the power is off.

A. D-C Voltmeter Check

A quick method of locating the defective stage is by the use of a d-c voltmeter.

With the amplifier removed from the instrument, proceed as follows:

1. Connect a 500-ohm 10-watt resistor across the output terminals of the amplifier.

2. Connect the 120-volt supply to power terminals (L_1 and L_2).

3. Turn gain control to zero (extreme counterclockwise position).

4. Connect negative lead of voltmeter to the ground connection on the amplifier. Test with the other voltmeter lead at the points listed in table, Figure 2.

The voltages given in the table (Figure 2) were taken with a 20,000 ohm per volt meter and with a line voltage of 117 volts. If the line voltage is greater or less than 117 volts, the d-c voltage given in the voltage table will vary proportionally. **For example:** If the line voltage is 110 volts, the B+ voltage instead of being approximately 320 volts will be $\frac{110}{117} = \frac{x}{320}$ or $x = \frac{110 \times 320}{117} = 300.$

Therefore, the B+ voltage will be approximately 300 volts with a line voltage of 110 volts.

All d-c voltages above 100 volts should not vary more than ± 10% from specified values.

Voltages between K_1, K_2, K_3 and K_4 and ground should not vary more than ± 0.5 volts from specified values.

Voltage between K_5 and ground should not vary more than ± 2 volts from specified value.

If B+ is low, replace V_4. If B_3, B_4 or B_5 is low, replace the plug-in filter capacitor with one known to be good. This capacitor contains C_{18}, C_{19} and C_{20}.

B. Testing with an Oscilloscope

For those who desire to locate the defective stage by tracing a test input signal step by step thru the amplifier with an oscilloscope, the following procedure should be followed:

1. Connect a 500-ohm 10-watt resistor across the output terminals of the amplifier.

2. Connect the 120-volt supply to power terminals (L_1 and L_2).

3. Connect the a-c test input signal generator to the amplifier input terminals.

4. Turn the gain adjustment to its maximum position (extreme clockwise position).

5. Connect the ground side of the oscilloscope to the amplifier chassis ground.

6. Connect test voltage to the vertical input terminals (Y axis) of the oscilloscope. Then, adjust horizontal sweep rate, as required, until a sine-wave pattern appears on the scope. See also directions furnished with oscilloscope.

(G1) **Signal:** Sine wave on screen. Note amplitude for comparison with the following tests.
No Signal: Check signal generator.

(P1) **Signal:** Amplitude should be about 40 times G_1.
No Signal: Defect in first stage. Check V_1. Check voltage from K_1 to ground and P_1 to ground (see d-c voltage table, Figure 2).

(X1) **Signal:** Same as P_1.
No Signal: Check C_2 and R_4.

(G2) **Signal:** Slightly less than P_1.
No Signal: Check C_3, R_4 and R_5.

(P2) **Signal:** Amplitude should be about 40 times greater than G_2.
No Signal: Defect in second stage. Check V_1. Check voltage from K_2 to ground and P_2 to ground (see d-c voltage table, Figure 2).

Next, reduce gain until setting on oscilloscope and picture approach original at G_1. Note amplitude for comparison with following test.

(X2) **Signal:** Amplitude about 1/5 that of P_2. If signal is abnormally high or low, check R_8, R_9, R_{10}, C_5, C_6, C_7 and R_{11}. If fault is found in this section, replace entire board or return amplifier to factory.

(X3) **Signal:** Same as X_2.
No Signal: Check C_8 and R_{12}.

(G3) **Signal:** Amplitude should be about the same as X_3.
No Signal: Check C_9 and R_{13}.

(P3) **Signal:** Amplitude should be about 50 times G_3.
No Signal: Defect in third stage. Check V_2. Check voltage from K_3 to ground and P_3 to ground (see d-c voltage table, Figure 2).

(X4) **Signal:** Same as P_3.
No Signal: Check C_{11} and R_{16}.

(G4) **Signal:** Less than X_4.
No Signal: Check C_{12} and R_{17}.

Next, reduce gain until setting on oscilloscope and picture approach original at G_1. Note amplitude for comparison with following test.

(P4) **Signal:** Amplitude should be about 50 times G_4.
No Signal: Defect in fourth stage. Check V_2. Check voltage from K_4 to ground and P_4 to ground (see d-c voltage table, Figure 2).

(G5) **Signal:** Same as P_4.
No Signal: Check C_{14}, and R_{21}.

(X5) **Signal:** Same as G_5.
No Signal: Check R_{22}.

(P5) **Signal:** Amplitude should be about 2 times G_5.
No Signal: Defect in fifth stage. Check V_3. Check voltage from K_5 to ground and P_5 to ground (see d-c voltage table, Figure 2).

(P) On terminal strip
Signal: Same as P_5.
No Signal: Check connections between P and P_5.

Note: At points P_5 & P a slight distortion in the sine wave will be noted.

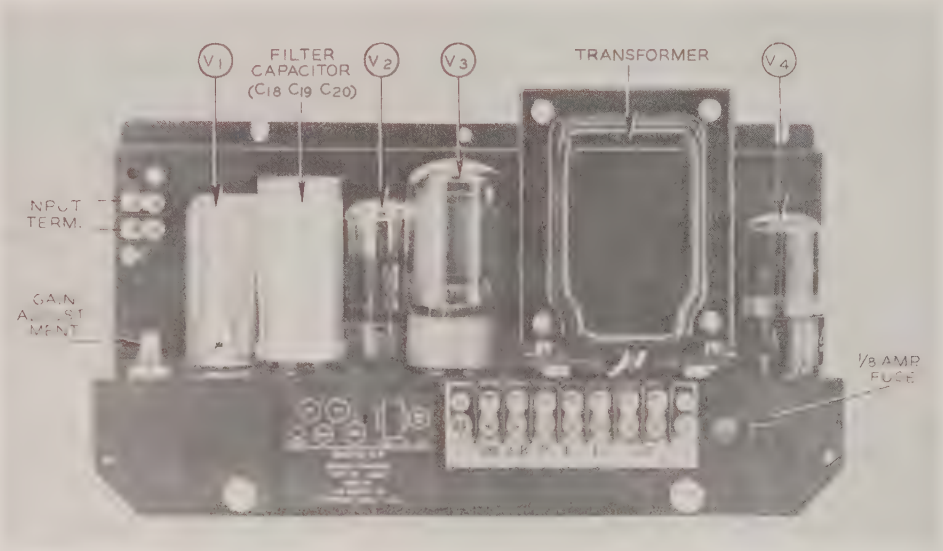

FIGURE 3. FRONT VIEW OF SERIES D AMPLIFIER

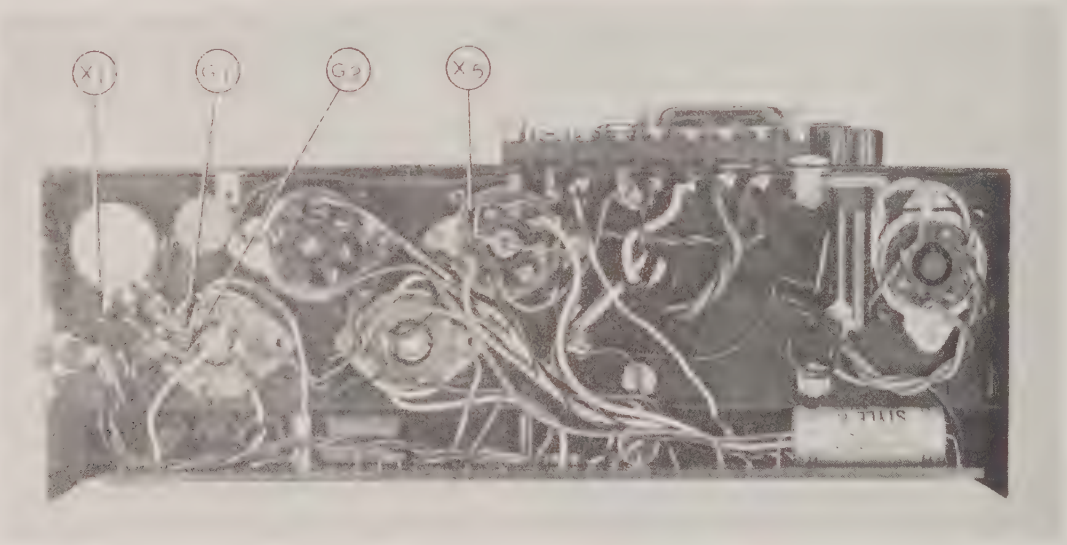

FIGURE 4. BOTTOM VIEW OF SERIES D AMPLIFIER

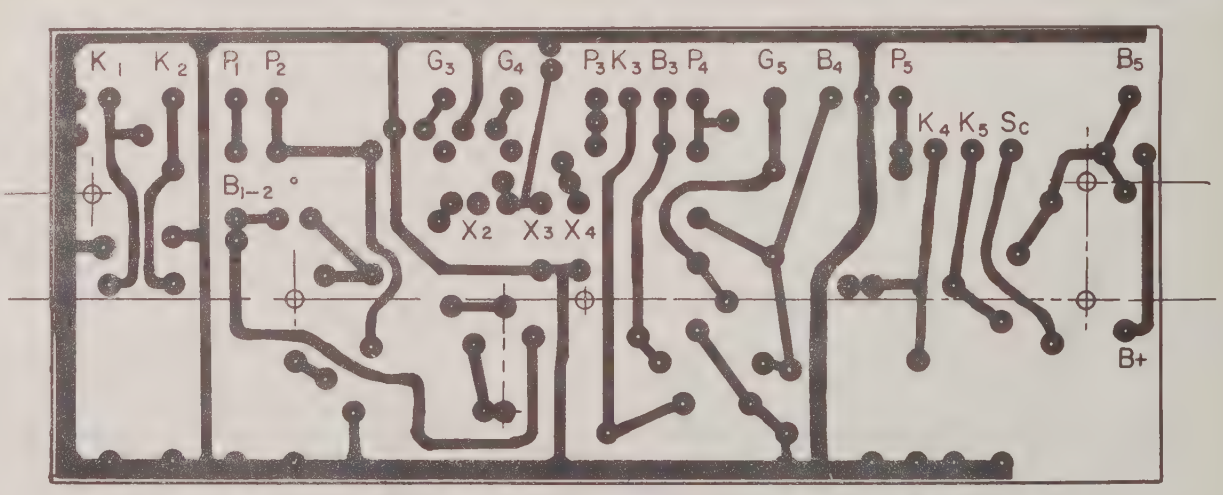

FIGURE 5. PRINTED CIRCUIT SHOWING TEST POINTS

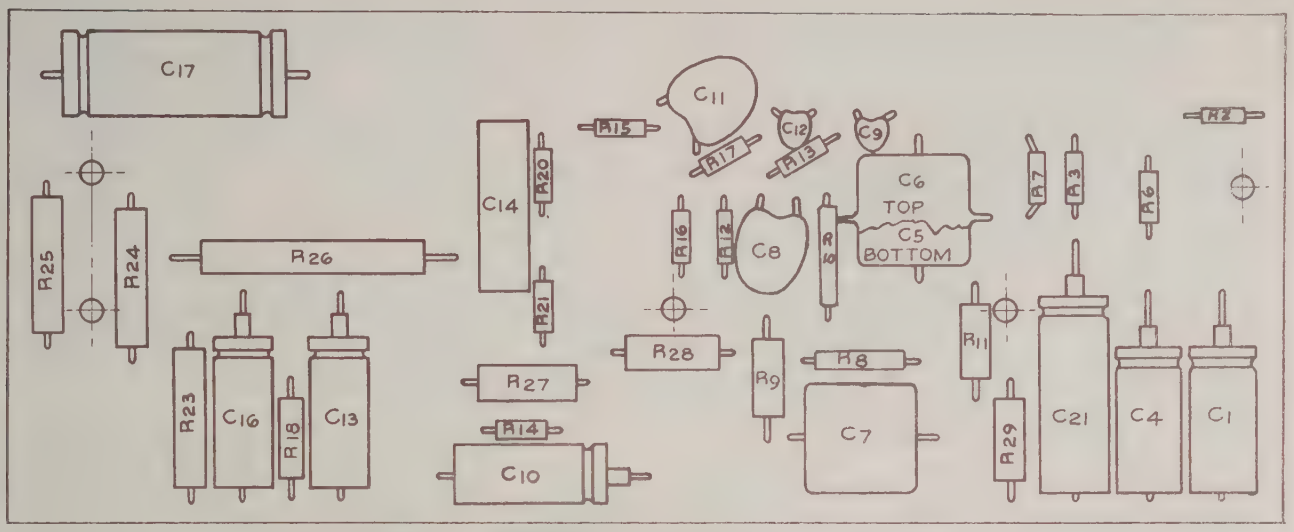

FIGURE 6. COMPONENT SIDE OF PRINTED CIRCUIT BOARD

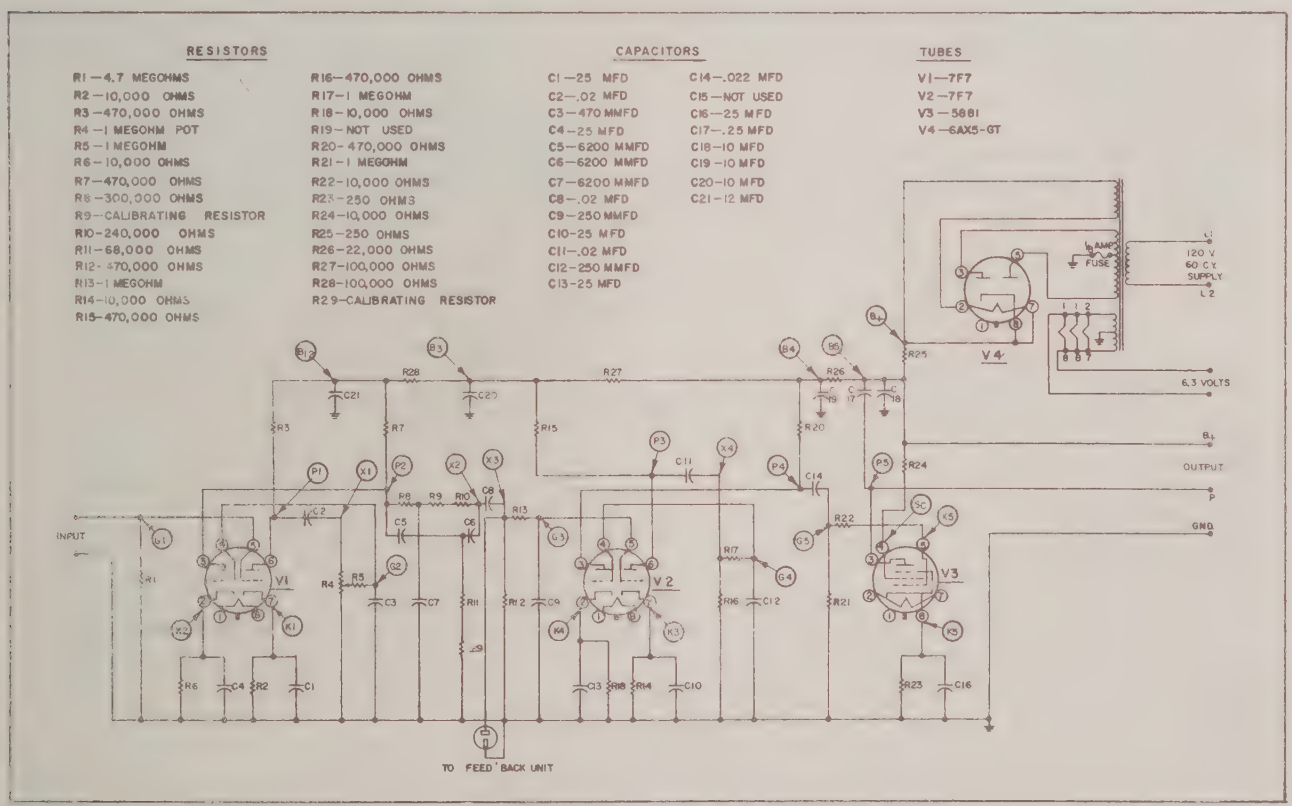

FIGURE 7. SCHEMATIC WIRING DIAGRAM OF SERIES D AMPLIFIER

NOTE: Wiring of Series D-3 (50 cycle) amplifier same as Series D except items C_5, C_6, & C_7 are 7500 MMF and C11 changes to .075 MFD.

C. Identifying Defective Part

When the defective stage is located from the above checks, the defective part of that stage may be identified. This is done by checking with an ohmmeter the resistors of that stage. All ohmmeter checks should be made with the power off and the plug-in capacitor and vacuum tubes removed. If the resistors are correct, it can generally be assumed that a capacitor or capacitors associated with that section of the circuit are defective. Test them by replacement.

This systematic checking of each resistor and capacitor in the defective stage will quickly identify the defective part.

D. Calibration of Printed Circuit Board For Series D (60 cycle) Amplifier.

The printed circuit board contains 2 calibrating resistors, identified as R9 and R29 on the schematic drawings.

These resistors are part of a double T network designed to suppress any 120 cycle signal. The network is tuned at the factory and should never require any field attention. If the capacitors and resistors in this network are damaged in the field, we would recommend purchasing a printed circuit board complete with the components shown in figure 6.

If it is necessary to change one of the resistors or capacitors in this network, in the field, it will be necessary to retune the network. To do this requires a 120 cycle oscillator, a sensitive a-c voltmeter or oscilloscope and 2 decade resistor boxes.

Connect the oscillator between P2 and ground. Set the oscillator at 120 cycles and apply 10 volts. CAUTION: Be sure that the amplifier is disconnected from the power lines at this time. Connect the sensitive a-c voltmeter or oscilloscope between X2 and ground. Connect a decade resistor box in place of R9 (10,000 to 150,000 ohms) and another in place of R29 (1000 to 15,000 ohms). Adjust resistors R9 and R29 until a minimum reading is obtained on the oscilloscope or meter. The suppression of 120 cycles in this filter should be between 300 and 1,000 to 1. This means that with a 10-volt input from the oscillator you should be able to reduce that signal to 33 mv. or less.

When the proper values for R9 and R29 are determined, obtain resistors of this value and install. These resistors should be wire wound with a tolerance of ± 10%.

E. Calibration of Printed Circuit Board For Series D-3 (50 cycle) Amplifier.

Calibration of printed circuit board for Series D-3 (50 cy) amplifier is the same as outlined in paragraph D above except that all reference to 120 cycles should be changed to 100 cycles.

The Bristol Company
Waterbury, Conn., 06720, U.S.A.

Printed in U.S.A.

BRISTOL® instruments

parts list

Revised: 11/73 P12055-A

(Replaces Issue of 1/69)

DYNAMASTER® WIDE STRIP RECORDER

MODEL 560 AND 570

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ACCO

Bristol Division

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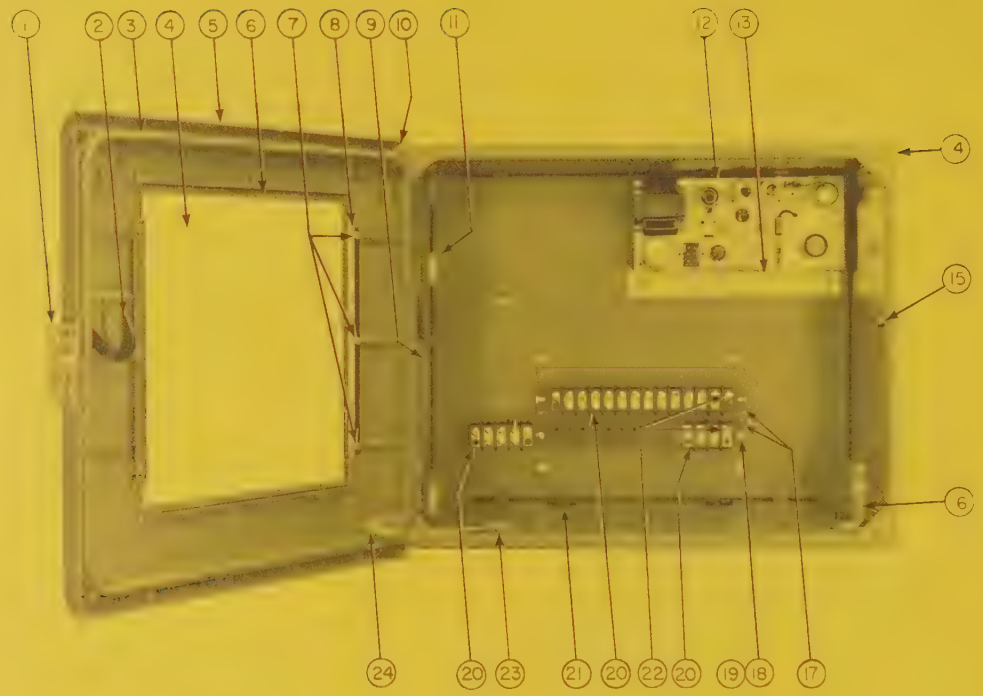


FIGURE 1. DOOR AND CASE INTERIOR

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	282615-00-8	Handle complete with lock
	282616-00-4	Handle without lock
	*287239-00-4	Stop pin
	*294738-00-2	Latch plate
2	288751-00-4	Hook complete
	282415-00-9	10-32 x 1/4" Bristo cup-point setscrew
	*282630-00-7	Flat spring
3	282608-00-1	Rubber gasket (62" long)
4	283644-00-1	Glass
5		Door complete (Specify model & serial number of instrument)
6	284725-00-5	Gasket (47" long)
7	282656-00-6	6 x 3/16" Fillister-head screw
8	285232-00-2	Glass clip
9	285236-00-8	Hinge bracket
	*266539-00-9	10-32 x 3/8" Fillister-head screw
	*266541-00-3	10-32 x 1/2" Fillister-head screw
	*282413-00-6	10-32 x 3/16" Bristo flat-point setscrew
10	282654-00-3	Door hinge
	*292693-00-1	10-32 x 7/16" Flat-head screw
11	343591-00-6	Hinge for hinged panel on 1-pen and multiple-point instruments
	343593-00-9	Hinge for hinged panel on 2-pen instruments
	*285208-00-4	Hinge pin
	212721-00-3	Washer
12		Amplifier (see separate parts list)
	334114-00-4	Filter (100K)
	334651-00-1	Filter (1K)
13	313139-00-8	Amplifier mounting strap
	266537-00-6	#10-32 x 1/4" Fillister-head screw
14		Case body complete (Specify model & serial number of instrument)
15	292126-00-0	Roller
	*296127-00-0	Roller stud
16	285220-00-4	Latch complete for hinged panel
	289659-00-0	1/4" - 20 x 3/8" Hexagon socket-head cap screw

* Not shown

KEY TO FIGURE 1. CONTINUED

17	286092-00-0	Terminal mounting strap (11 7/8" long)
	286093-00-6	Terminal mounting strap (8 13/16" long)
18		Terminal strap mounting post
	234954-00-0	1/2" long
	288102-00-2	1 1/4" long
	288106-00-8	2" long
	289869-00-5	2 3/4" long
19		Terminal strap mounting screw
	266568-00-9	10-32 x 3/4" Flat-head screw
	266545-00-9	10-32 x 3/4" Fillister-head screw
	266572-00-6	10-32 x 1 1/2" Flat-head screw
	265984-00-9	10-32 x 1 1/2" Fillister-head screw
	266575-00-5	10-32 x 2 1/4" Flat-head screw
	288107-00-4	10-32 x 2 1/4" Fillister-head screw
	289870-00-3	10-32 x 3" Round-head screw
20		Terminal blocks
	274804-00-0	2 terminals
	287235-00-9	3 terminals
	287236-00-5	4 terminals
	293670-00-5	5 terminals
	287238-00-8	6 terminals
	276643-00-3	8 terminals
	285288-00-8	9 terminals
	288098-00-5	12 terminals
		Terminal marking strip (give marking and number of terminals)
21	286026-00-7	Rubber grommet (for 1 11/16" conduit hole)
	272691-00-3	Rubber grommet (for 1 1/16" conduit hole)
22	287936-00-7	#10 x 1" Self-tapping screw
	*272166-00-6	Spacer
	*210075-00-7	Washer
23	287392-00-7	Door-stop screw
	244739-00-5	Collar
	286027-00-3	Door stop
24	240066-00-6	8/32 x 1/4" Fillister-head screw
		Case Mounting Brackets
	*292030-01-0	Bracket
	*232193-00-2	1/4" - 20 x 1/2" Hex-head screw for mounting bracket to case
	*283848-00-6	5/16" - 24 x 2 1/2 Headless screw for flush-mounted case
	*250706-00-8	5/16" - 24 Hex nut for screw 283848-00-6
	*292031-00-9	Cup washer for screw 283848-00-6

*Not shown

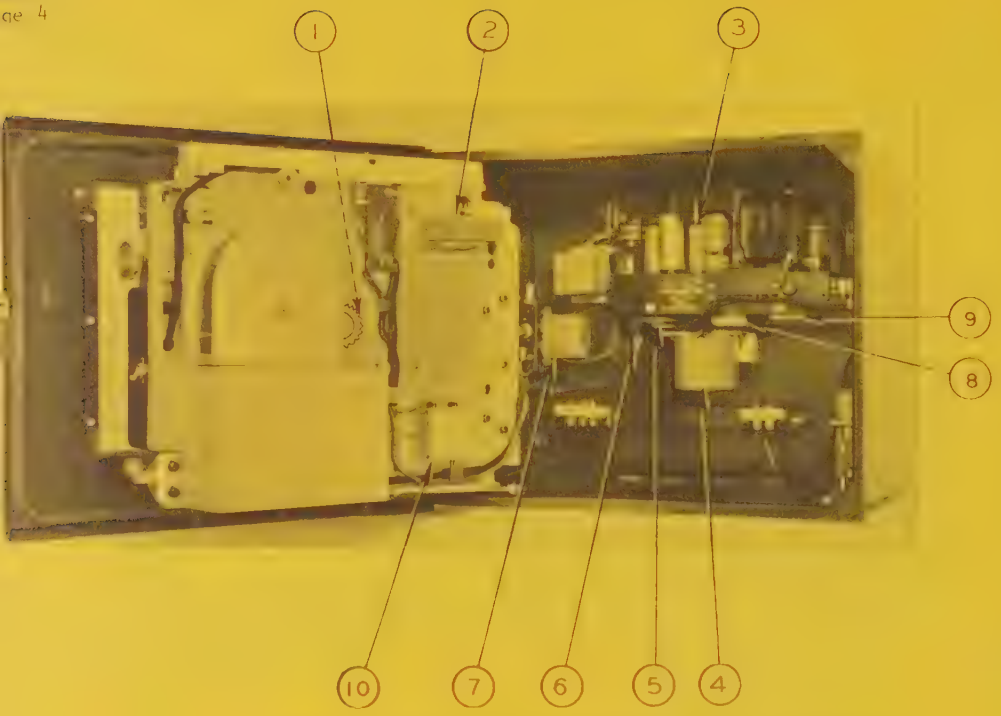


FIGURE 2. PHOTO OF HIGH-SPEED (0.4 SEC.) DYNAMASTER

EM	PART NO.	DESCRIPTION
	308351-00-2	Motor-generator assembly complete
	235639-00-5	#8 Shakeproof washer
	294855-00-9	#8-32 Nut
	310593-00-0	#8-32 x 5/16" Flat-head screw
	308349-00-8	Mounting plate complete
	332446-00-0	Motor-generator
	304989-00-2	Pinion complete (on motor-generator shaft)
	282403-00-0	#6-40 x 1/8" Flat-point setscrew
	304996-00-9	Spring
	304993-00-0	Gear hub collar
	304992-00-3	Rear gear assembly
	304990-00-0	Front gear assembly
2	334806-00-3	Rectifier for pen-lifter relay
	*218339-00-3	6-40 x 3/16" Fillister-head screw for mounting rectifier
3	341096-00-8	Series "D" amplifier (see parts list P12077 for breakdown)
	302229-00-0	Amplifier shelf
4	292736-00-2	Output transformer
	*266537-00-6	10-32 x 1/4" Fillister-head screw for mounting transformer
	*235638-00-5	#10 Lockwasher
5	303820-00-4	Thyrite disk complete (used with 332162-00-1 only)
	*262290-00-6	6-40 x 1 1/16" Fillister-head screw for mounting Thyrite disk
	*243040-00-8	Washer
	*302241-00-0	Spacer
	*220903-00-0	6-40 Hexagon nut
6	302517-00-6	Stick resistor (used with 332162-00-1 only)
	*292315-00-7	6-40 x 2" Fillister-head screw for mounting stick resistor
	*243040-00-8	Washer
	*200256-00-9	Retaining washer
7	331216-00-0	Feed-back unit complete (used with 332162-00-1 only)
	370455-01-0	Transformer
	291050-00-0	Rheostat (60 ohm)
	302242-00-7	Rheostat (2 meg.)
	283979-00-3	Resistor (470K, 1/2 watt)
	290575-00-1	Resistor (10K, 1 watt)
	284549-00-2	Potentiometer cap
	332702-00-6	Feedback unit complete (used with 308351-00-02 only)
8	293740-00-3	Capacitor (1.25 mfd. 600 V.)
	*266537-00-6	10-32 x 1/4" Fillister-head screw for mounting capacitor
	*235638-00-5	#10 Lockwasher
9	274480-00-0	Capacitor (.5 mfd. 600 V.)
0	290059-00-3	Capacitor (1.00 mfd. 600 V.)

Not Shown

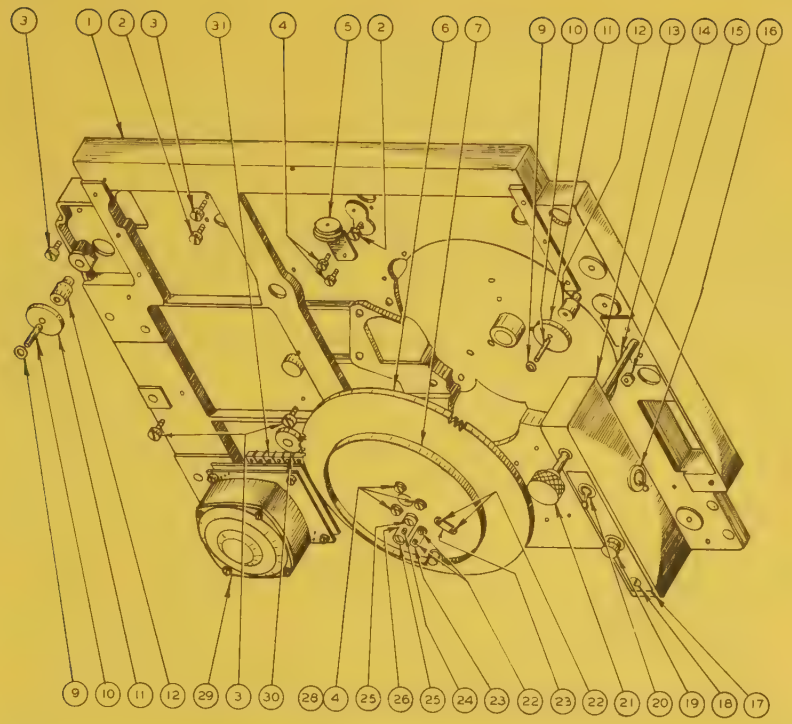


FIGURE 3. FRONT OF HINGED PANEL

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	298350-00-9	Mounting frame for 1-pen and multiple point instruments
	331151-00-6	Mounting frame for 2-pen instruments
2	266539-00-9	10-32 x 3/8" Fillister-head screw
3	266539-00-9	10-32 x 3/8" Fillister-head screw for 2-pen instruments
	242098-00-2	10-32 x 7/16" Fillister-head screw for multiple-point instruments
4	231427-00-0	6-40 x 5/16" Fillister-head screw
5	288183-00-2	Pulley and bracket complete
	276283-00-7	Pulley
	279854-00-5	Retaining ring
6	292578-00-8	Bull gear complete for 3, 4.5, 7 & 24 second pen travel, includes setscrew and items 4, 7, 22 thru 26 and 28
	286052-00-8	Bull gear & hub only for 3, 4.5, 7 & 24 second pen travel
	293929-00-9	Bull gear complete for 1 & 0.4 second pen travel, includes set-screw & items 4, 7, 22 thru 26 & 28
	293360-00-6	Bull gear & hub only for 1 and 0.4 second pen travel
	289049-00-8	5/16- 18 Flat-point setscrew
	332445-00-3	Bull gear for new style 0.4 second

KEY TO FIGURE 3. CONTINUED

ITEM	PART NO.	DESCRIPTION
7	285255-00-2	Sheave
	289030-00-5	Drive cord
9	280607-00-8	Retaining ring (1/8" shaft) (see item 11)
10	285291-00-9	Pulley shaft (see item 11)
11	292579-00-4	Cord-pulley assembly complete including setscrew and items 9, 10 & 12 for 3, 4.5, 7 and 24 se pen travel
	302205-00-4	Cord-pulley assembly complete including setscrew and item 12 for 1 and 0.4 second pen travel
	282403-00-0	Setscrew for item 11
12	285292-00-5	Mounting stud for 3, 4.5, 7 and 24 second pen travel (see item 11)
	302210-00-8	Mounting stud for 1 and 0.4 second pen travel (see item 11)
13	286025-00-0	Switch housing for 1-pen and multiple-point instrument
	292934-00-9	Switch housing same as above, but drilled for 2-speed chart-drive switch
	331557-00-2	Switch housing for 2-pen instrument
14	288157-00-1	Control-knob shaft
15	272055-00-0	10-32 Hexagon nut
16	262827-00-0	2-speed chart-drive switch
17	286098-00-8	Switch plate for d-c Potentiometer type instrument (2 switches)
	286099-00-4	Switch plate for a-c bridge type instrument (1 switch)
18	291089-00-3	6-40 x 1/4" Fillister-head screw
19	254261-00-0	Push-button switch
20	262182-00-9	Toggle switch (on-off)
21	289132-00-2	Control knob
	282413-00-6	10-32 x 3/16" Flat-point setscrew
22	239770-00-5	6-40 x 1/4" Fillister-head screw
23	285319-00-[illegible]	Cord clamp
24	276273-00-1	Tension shaft
25	220021-00-7	6-40 x 1/4" Flat-head screw
26	276276-00-0	Tension-shaft clamp
28	243040-00-[illegible]	#6 Lockwasher
29		Balancing motor assembly (specify model & serial number of instrument)
30		Motor pinion
	291930-00-0	for instruments with 24-second pen travel
	291930-00-0	for instruments with 12-second pen travel
	286036-00-2	for instruments with 4.5-second pen travel
	291932-00-2	for instruments with 3-second pen travel
	304988-00-6	for instruments with 0.4-second pen travel
	286029-00-6	Terminal block
	286031-00-0	Marking strip
	245081-00-3	Spacers
	241519-00-4	Screws
	286030-00-4	Cover
	210075-00-7	Washer
	243040-00-8	Washer

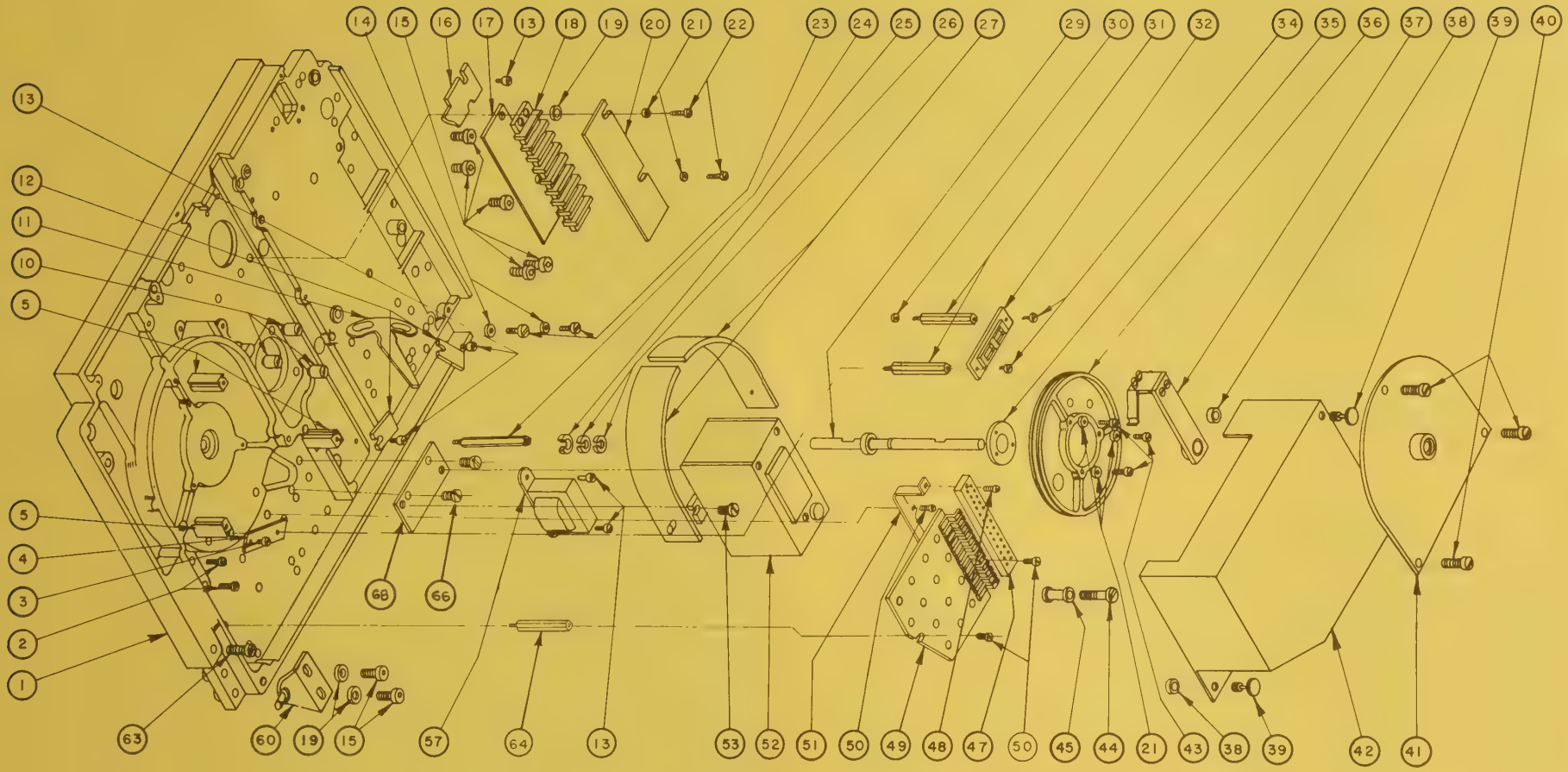


FIGURE 4. REAR OF HINGED PANEL

KEY TO FIGURE 4.

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	298350-00-9	Mounting frame
2	266541-00-3	10-32 x 1/2" Fillister-head screw
3	291089-00-3	6-40 x 1/4" Special-head screw
4	289118-00-0	Clamp
5	289112-00-1	Post
10	286053-00-4	Motor mounting nuts
11	285272-00-4	Gear stop (St'd)
	293320-00-4	Gear stop for 1-sec. pen speeds and faster
12	285273-00-0	Cable clamps
13	239770-00-5	6-40 x 1/4" Fillister-head screw
14	210075-00-7	Washer
15	289660-00-9	1/4" -20 x 1/2" Hex-cap screw
16	291678-00-9	Cable cover
17	295612-00-2	Terminal block marking strip (8 point)
18	295611-00-6	Terminal block
19	245081-00-3	Spacer
20	295614-00-5	Cover, terminal block
21	243040-00-8	#6 Lockwasher
22	241519-00-4	6-40 x 3/4" Fillister-head screw
23	266539-00-9	10-32 x 3/8" Fillister-head screw
24	286014-00-9	Post
25	305078-00-3	Thrust washer
26	289117-00-3	Retaining ring
27	289865-00-0	Cover for slidewire
	303805-00-5	Cover for slidewire (used on .4 second instruments)
29	293034-00-1	Balancing mechanism shaft (560)
	296809-00-4	Balancing mechanism shaft (570) deep case only
	304010-00-6	Balancing mechanism shaft (570 double front set)
	304008-00-1	Balancing mechanism shaft (573 & 574 0.4 sec. instruments)
	305080-00-8	Bearing
30	295425-00-8	Washer
31	295424-00-1	Post
32		Slidewire trimmer, give model, range and serial number of instrument
34	251556-00-0	4-48 x 5/16" Fillister-head screw
35	305079-00-0	Cover plate for bearing
	301872-00-7	Mounting screws
36		Slidewire complete, specify model, range and serial number of instrument
37	316905-00-3	Contact arm assembly
	331464-00-4	Contactor
38	282381-00-7	Washer
39	255785-00-3	10-32 Special thumb screw
40	265984-00-9	#10-32 x 1 1/2" Fillister-head screw
41	289104-00-9	Cover for slidewire
42	289113-00-8	1 or 2 pen ac-dc cover
43	219536-00-7	6-40 x 5/8" Fillister-head screw
	236344-00-5	6-40 x 5/8" Fillister-head screw for A-C instruments
44	240069-00-5	6-40 x 11/16" Fillister-head screw
45		Calibration spool, give model, range and serial number of instrument and information on label of spool
47	304951-00-5	12-Point terminal block
48	291089-00-3	6-40 x 1/4" Fillister-head screw
49	306016-00-1	Plug-in card
50	239770-00-5	6-40 x 1/4" Fillister-head screw
51	307136-00-0	Mounting strap
52	333547-00-4	Reference voltage source (Zener)
53	240066-00-6	8-32 x 1/4" Fillister-head screw
57	284245-00-3	Transformer (50-60 cycle) Standard a-c bridge
	298090-00-7	Transformer (50-60 cycle) As required for strain gauges
	291029-00-0	Transformer (50-60 cycle) As required for conductivity
60	285296-00-0	Latch pin
63	247042-00-5	10-32 x 1 1/8" Fillister-head screw
64	288141-00-8	Post
	239770-00-5	6-40 x 1/4" Fillister-head screw
66	220335-00-1	Screw
68	307046-00-1	Plate

NOTE: See att. TIII when two plug-in cards are required.

Series L10 Amplifier only

KEY TO FIGURE 5.

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
		Chart drive complete, without motor
	279220-00-6	with aluminum roll
	282424-00-8	with rubber covered roll
	351008-00-4	Swing out chart drive (for two-pen recorder)
1	272403-00-8	Retaining ring
2	235638-00-5	#10 Lockwasher
3	267029-00-4	10-32 x 5/16" Fillister-head screw
4	279208-00-6	Loading-spindle adjusting nut
	*282404-00-7	6-40 x 3/16" Flat-point setscrew for item 4
5	288885-00-7	Collar, not including setscrew
	*282404-00-7	6-40 x 3/16" Flat-point setscrew for item 5
6	239425-00-6	10-32 x 1/4" Special-head screw
7	279290-00-4	Bearing screw
8	266539-00-9	10-32 x 3/8" Fillister-head screw
9	279203-00-4	Foot for 1-pen and multiple-point instruments
	302078-00-2	Foot for 2-pen instruments
10	279291-00-0	Bearing
11	211386-00-6	Hexagon nut
12	279288-00-0	End plate (left hand) for all instruments except those with swing-out chart drive
	331465-00-0	End plate (left-hand) for 2-pen instruments with swing-out chart drive
13	279243-00-6	Shaft and hub complete
14	279236-00-0	Clutch facing
14A	305473-00-0	Washer
15	279241-00-3	Gear (80T-48P)
16	279237-00-6	Washer
17	279240-00-7	Spring
18	279235-00-3	Washer
19	279296-00-2	Chart-guide support rod (note: substitute item 43 for 2-pen instruments)
20	279295-00-6	Chart guide
	*230628-00-1	4-48 x 3/16" Fillister-head screw
21	294587-00-4	Spacer for chart cut-off plate
22	294030-00-0	Chart feed roll (aluminum)
	294031-00-6	Chart feed roll (rubber covered)
23	273927-00-0	2-64 x 7/32" Fillister-head screw
24	279231-00-8	Sprocket (26 tooth) not including setscrew
	*282414-00-2	10-32 x 1/4" Flat-point setscrew
25	283895-00-4	Bearing nut
26	283849-00-2	Sprocket (16 tooth)
27	221252-00-2	Washer
28	231427-00-0	6-40 x 5/16" Fillister-head screw
29	284743-00-3	Knob
	*311387-00-4	10-32 x 1/4" Nyloc cup-point setscrew
30	243040-00-8	#6 Lockwasher
31	279289-00-6	End plate (right hand) for 1-pen and multiple-point instrument
	302070-00-1	End plate (right hand for 2-pen instruments)
	*285216-00-7	Spring post } order assembled to end plate 302070-00-1
	*302071-00-8	Latch lever
	*243184-00-0	Shim
	*302074-00-7	Stud
	*285217-00-3	Stud
	*252618-00-9	Washer
	*242098-00-2	10-32 x 7/16" Fillister-head screw
	*285214-00-4	Latch spring for swing-out chart drive for 2-pen instruments
32	218339-00-3	6-40 x 3/16" Fillister-head screw
33	279205-00-7	Latch spring
	302075-00-3	Latch spring for 2-pen instruments
34	279250-00-2	Rewind knob, not including setscrew
	*303832-00-2	10-32 x 1/8" Flat-point setscrew
35	279247-00-1	Thrust washer
36	295498-00-5	Rewind shaft
37	279257-00-7	Thrust washer
38	279253-00-1	Spring
39	279252-00-5	Sprocket (16 tooth) and hub
40	279248-00-8	Clutch facing
41	279256-00-0	Loading spindle
42	282380-00-0	Spring housing
43	279282-00-1	Brace rod
44	279238-00-2	Spring
45	279200-00-5	Spring-tension nut
46	279228-00-7	Chain

*Not Shown

(continued on page 9)

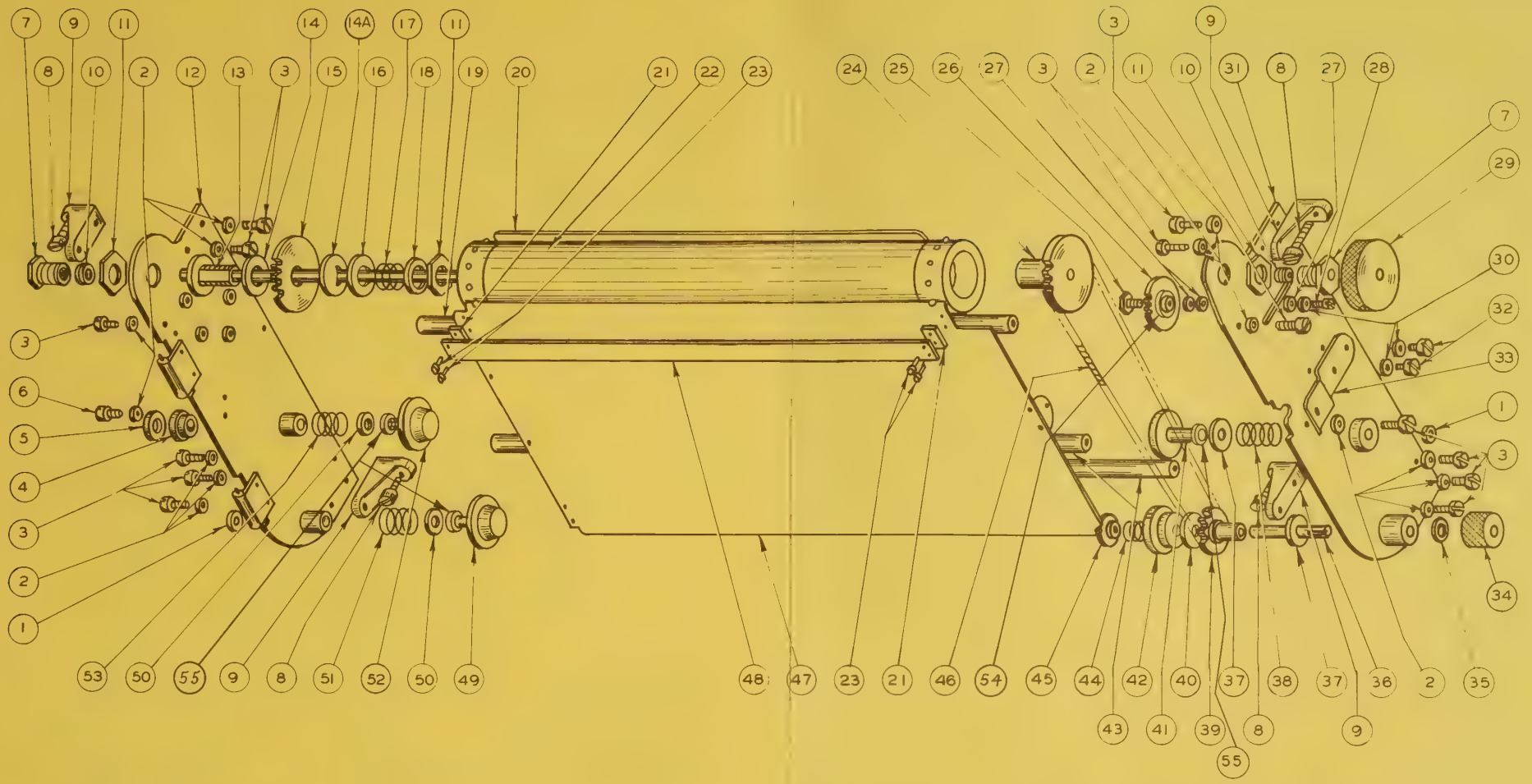


FIGURE 5. CHART-DRIVE MECHANISM WITHOUT MOTOR

ITEM	PART NO.	DESCRIPTION
47	279284-00-4	Chart plate (note: when used with chart cut-off guide, order drilled per sheet 294426-00-0
48	294586-00-8	Chart cut-off guide
49	279263-00-7	Rewind spindle
50	279265-00-0	Spring collar
51	279264-00-3	Spring
52	305077-00-7	Loading spindle
53	279232-00-4	Spring
	*263891-00-3	Chart rewind tube (cardboard)
	*286021-00-5	Chart clip
54	210075-00-7	Washer, fits over item 26
55	305785-00-1	Washer

NOT SHOWN PARTS FOR SWING OUT CHART DRIVE FOR 2-PEN INSTRUMENTS

331155-00-1	Hinge
266562-00-0	10-32 x 3/8" Flat-head screw for mounting hinge, part #331155-00-1
266539-00-9	10-32 x 3/4" Fillister-head screw for mounting hinge, part #331155-00-1
302079-00-9	Hinge pin
332414-00-0	10-32 x 1/4" Flat-point setscrew
331502-00-3	Tie bar (Lower)
331503-00-0	Tie bar (Upper)
296866-00-8	10-32 Shoulder screw
286324-00-8	10-32 x 1/2" Hexagon-socket cap screw

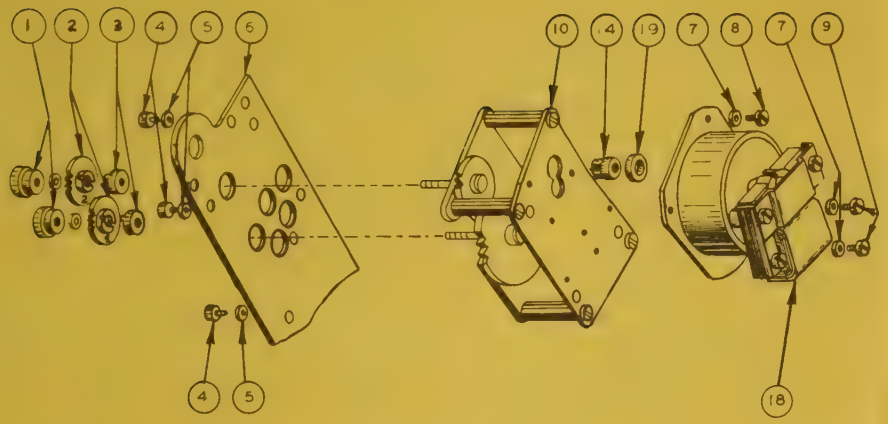


FIGURE 6. LOW-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 2- or 4-RPM TELECHRON MOTOR

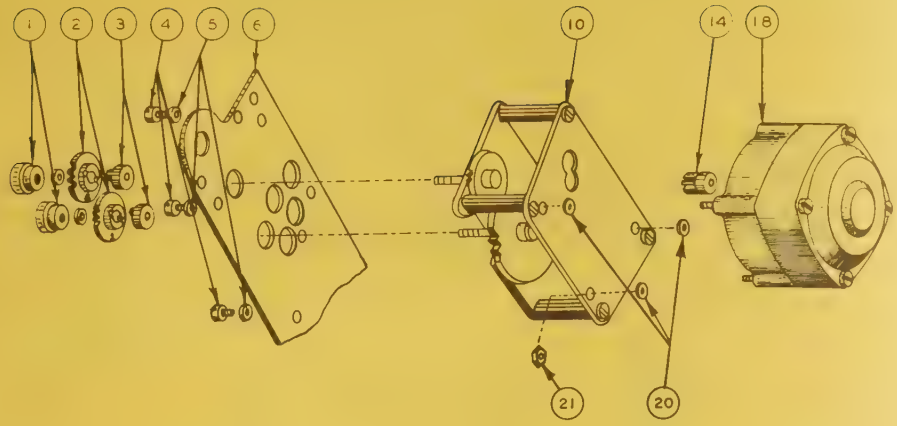


FIGURE 7. LOW-SPEED CHART DRIVE MOTOR ASSEMBLY USING 10- or 60-RPM HOLTZER-CABOT MOTOR

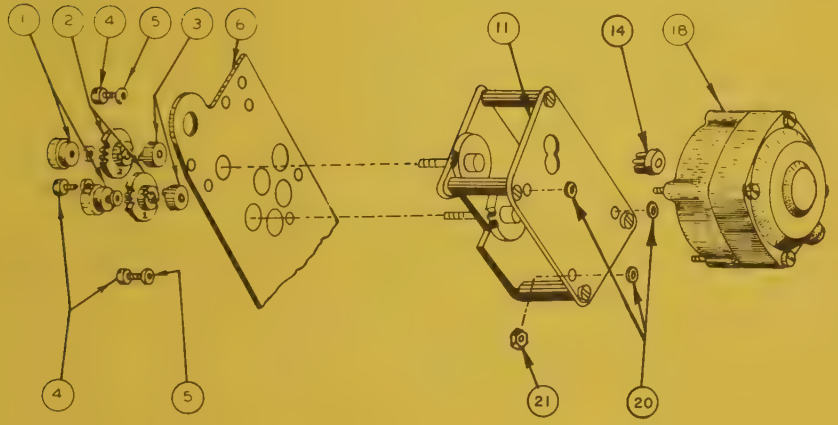


FIGURE 8. HIGH-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 4-, 10- or 60-RPM HOLTZER-CABOT MOTOR

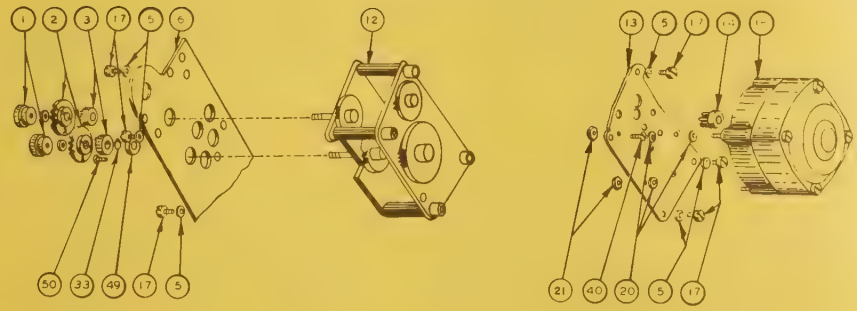


FIGURE 9. TWO-SPEED CHART-DRIVE MOTOR

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

KEY TO FIGURES 6. THRU 9.

ITEM	PART NO.	DESCRIPTION
1	279209-00-2	Knurled nut
	235638-00-5	Lockwasher
2		Change gears (see table figure 21)
3	279210-00-0	Change-gear collar, not including setscrew
	*282403-00-0	6-40 x 1/8" Flat-point setscrew for item 3
4	266372-00-7	#6-40 Shoulder screw
5	235638-00-5	#10 Lockwasher
6		Left-hand chart-drive plate (see figure 5, item 12)
7	243040-00-8	#6 Lockwasher
8	219536-00-7	6-40 x 5/8" Fillister-head screw
9	239770-00-5	6-40 x 1/4" Fillister-head screw
10	309062-00-4	Gear train complete
11	309061-00-8	Gear train complete
12		Gear train complete
	341021-00-8	60:1 ratio
	341022-00-4	30:1 ratio
	341023-00-0	10:1 ratio
13	301531-00-5	Mounting plate for two-speed chart-drive motor
14	253086-00-0	Motor pinion (14T-48P) (not including setscrew) for low-speed chart drive
	251590-00-3	Motor pinion (16T-48P) (not including setscrew) for high-speed chart drive
	301532-00-1	Motor pinion (16T-48P) (not including setscrew) for 2-speed chart drive
	282403-00-0	6-40 x 1/8" Flat-point setscrew for above
17	266372-00-7	6-40 Shoulder screw
*18		Chart drive motors
	286058-00-6	Telechron C5 (120 volt, 60 cycle, 2 rpm)
	286059-00-2	Telechron C5 (120 volt, 50 cycle, 2 rpm)
	292110-00-6	Telechron C5 (120 volt, 60 cycle, 4 rpm)
	292111-00-2	Telechron C5 (120 volt, 50 cycle, 4 rpm)
	296738-00-0	Holtzer-Cabot RWC2505 (120 volt, 60 cycle, 4 rpm)
	332274-00-4	Holtzer-Cabot RBC2505 (120 volt, 50 cycle, 4 rpm)
	288060-00-8	Holtzer-Cabot RWC2505 (120 volt, 60 cycle, 10 rpm)
	332275-00-0	Holtzer-Cabot RBC2505 (120 volt, 50 cycle, 10 rpm)
	253680-00-0	Holtzer-Cabot RWC2505 (120 volt, 60 cycle, 60 rpm)
	254603-00-9	Holtzer-Cabot RWC2505 (120 volt, 50 cycle, 60 rpm)
	292128-00-2	Holtzer-Cabot RWC2510 (120 volt, 60 cycle, 60 rpm)
	331277-00-0	Holtzer-Cabot RBC2505 (120 volt, 60 cycle, 1 rpm)
	331276-00-3	Holtzer-Cabot RBC2505 (120 volt, 60 cycle, 2 rpm)
	331279-00-2	Holtzer-Cabot RBC2510 (120 volt, 60 cycle, 60 rpm)
	255327-00-5	Bodine (120 volt, 60 cycle, 4 rpm)
19	279278-00-4	Locating ring
20	202420-00-0	Washer (3 required)
21	294855-00-9	8-32 Hex nut (3 required)
33	279854-00-5	Retaining ring
40	237751-00-3	6-40 x 5/8" Flat-head screw
49	213256-00-2	Collar
50	220335-00-1	6-40 x 5/16" Flat-head screw

*Not Shown

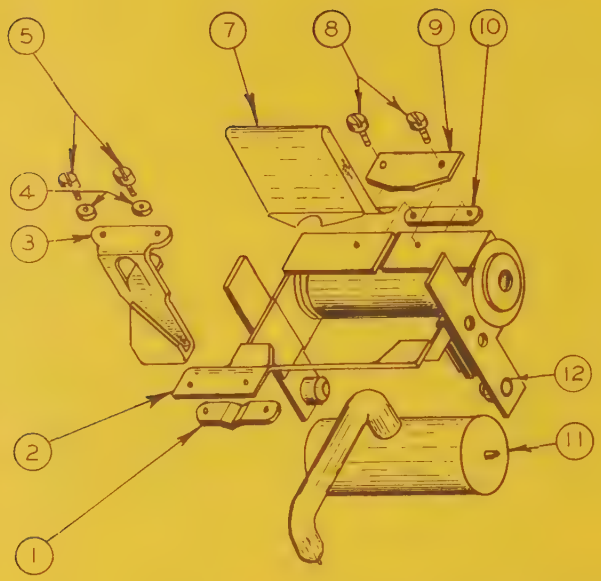


FIGURE 10. PEN ASSEMBLY FOR A STANDARD 1-PEN RECORDER

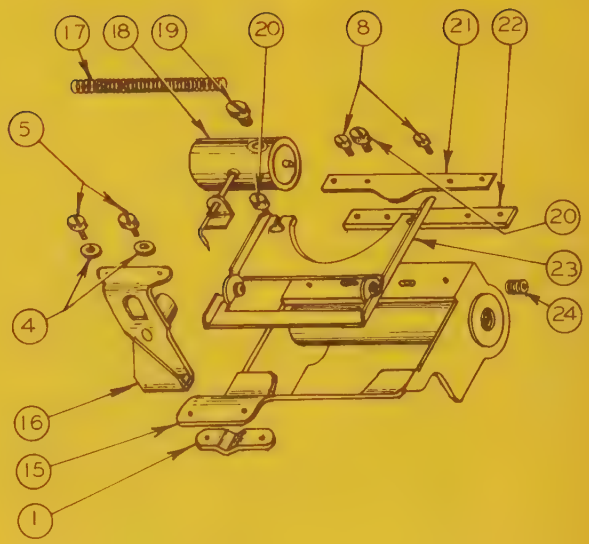


FIGURE 11. PEN ASSEMBLY FOR A 0.4 SEC. RECORDER

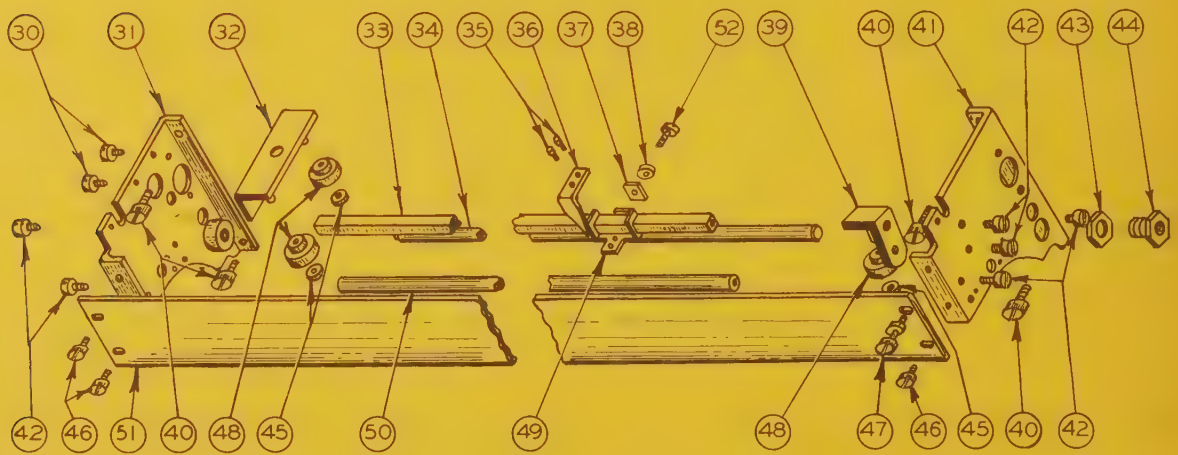


FIGURE 12. PEN-ASSEMBLY SUPPORT FOR A 1-PEN RECORDER

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

KEY TO FIGURES 10. THRU 12.

ITEM	PART NO.	DESCRIPTION
1	285230-00-0	Indicator clamp
2	293348-00-6	Pen-carriage assembly complete, less pen
3	285224-00-0	Indicator
4	237267-00-4	Washer
5	265071-00-3	3-56 x 1/8" Fillister-head screw
7	293358-00-1	Spring clip
8	230628-00-1	4-48 x 3/16" Fillister-head screw
9	285228-00-5	Cord clamp
10	285229-00-1	Strap
11	285206-00-1	Standard Pen (Glass)
	304935-00-1	Metal pen (large bore)
	295377-00-3	Metal pen (standard)
12	304595-00-4	Pivot screw
15	302212-00-0	Pen-carriage assembly complete, less pen (for 0.4-second pen speed)
16	302213-00-7	Indicator (for 0.4-second pen speed)
17	239890-00-0	Tension spring
18	302200-00-2	Pen for 0.4-second pen speed (includes item 19)
19	302211-00-4	Filter cap (included in item 18)
20	302218-00-9	Thumb screw
21	302222-00-6	Cord clamp
22	302223-00-2	Strap
23	331212-00-5	Pen mounting (includes item 24)
24	304595-00-7	6-32 Pivot screw (included in item 23)
30	218339-00-3	6-40 x 3/16" Fillister-head screw
31	285298-00-3	Left-hand support bracket (standard)
	302227-00-8	Left-hand support bracket complete (0.4 second pen speed)
		Left-hand support bracket only (0.4 second pen speed)
	301568-00-6	Pen-stop adjusting screw
	268556-00-8	10-32 Jam nut for adjusting screw
	247622-00-1	Washer for adjusting screw
	301567-00-0	Bumper, on end of adjusting screw
	266537-00-6	10-32 x 1/4" Fillister-head screw, to mount bracket 302225-00-0
	235638-00-5	#10 Lockwasher for above screw
32	288185-00-5	Control-Index-pulley bracket complete (includes items 45 and 48)
33	288188-00-4	Control-Index support rod
34	285271-00-8	Pen-support rod
35	293976-00-7	2-64 x 3/32" Fillister-head screw
36	288189-00-0	Control Index
37	288191-00-5	Indicator-cord clamp
38	276293-00-2	2-64 Thumb nut
39	288181-00-0	Control-index-pulley bracket complete, (includes items 45 and 48)
40	266539-00-9	10-32 x 3/8" Fillister-head screw
41	288249-00-3	Right-hand support bracket (standard)
	302224-00-9	Right-hand support bracket complete (0.4 second pen-speed)
42	239770-00-5	6-40 x 1/4" Fillister-head screw
43	285269-00-3	7/16"-27 Hex nut
44	285268-00-7	Bearing screw
45	279854-00-5	Retaining ring (3/16" shaft)
46	291089-00-3	6-40 x 1/4" Special-head screw
47	261682-00-8	6-40 Double-head screw
48	276283-00-7	Cord pulley
49	288190-00-9	Pointer bracket
	240018-00-1	2-64 x 1/4" Fillister-head screw
50	285256-00-9	Pen-carriage guide rod
51		Scale (order by model and serial number of instrument)
52	240018-00-1	2-64 x 1/4" Fillister-head screw

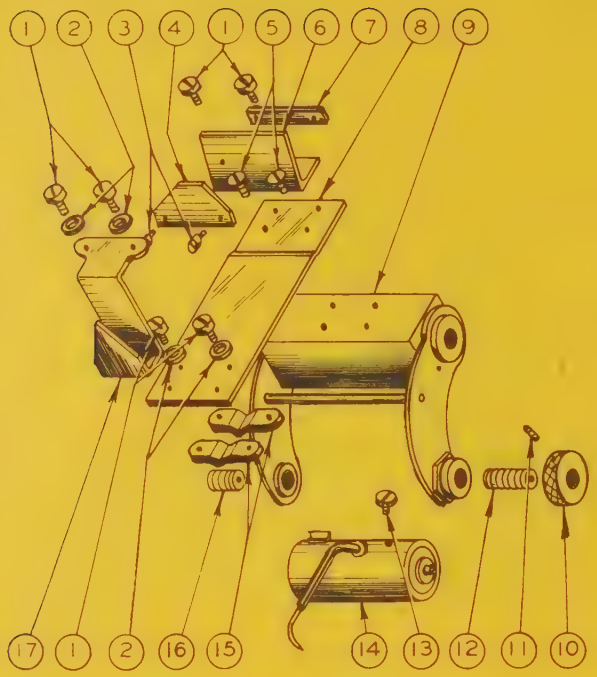


FIGURE 13. UPPER (NO. 2) PEN ASSEMBLY FOR 2-PEN RECORDER

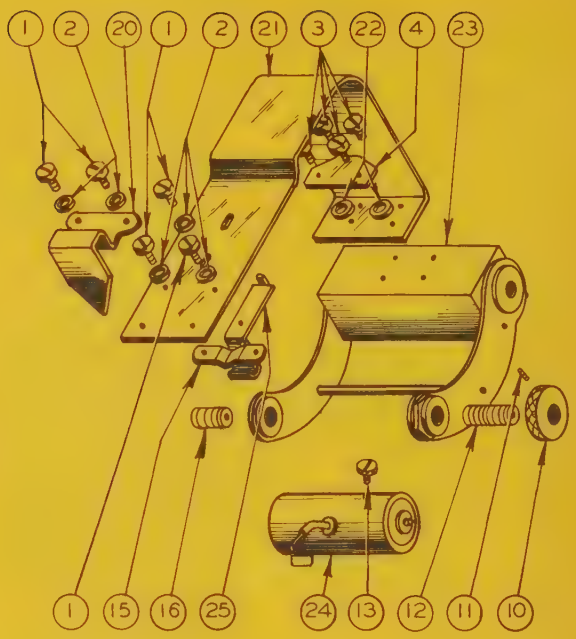


FIGURE 14. LOWER (NO. 1) PEN ASSEMBLY FOR 2-PEN RECORDER

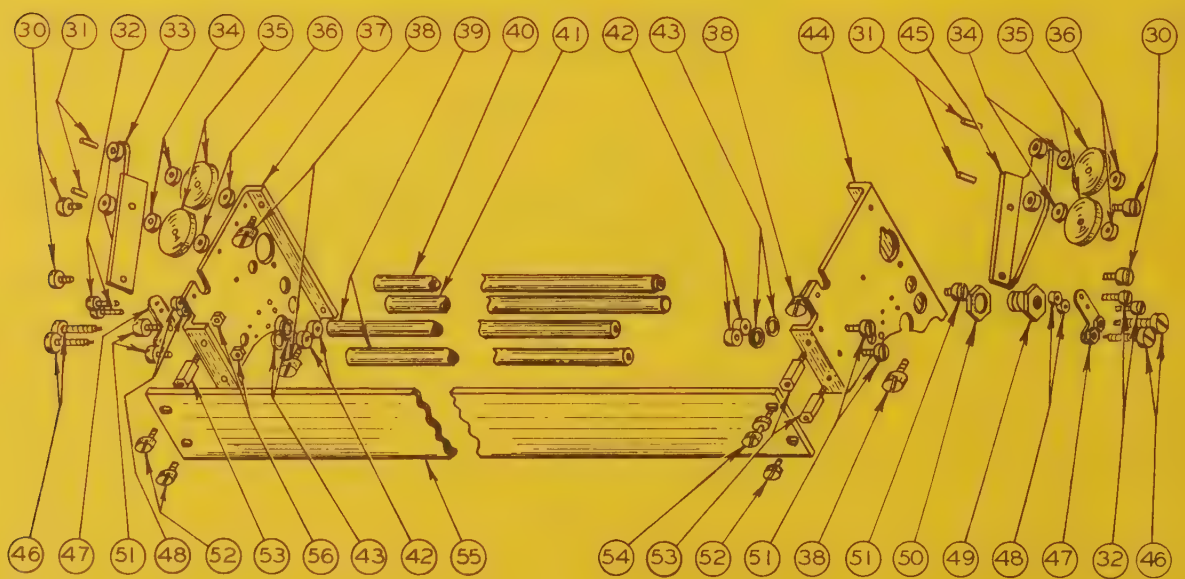


FIGURE 15. PEN ASSEMBLY SUPPORT FOR 2-PEN RECORDER

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

KEY TO FIGURES 13. THRU 15.

ITEM	PART NO.	DESCRIPTION
1	265071-00-3	3-56 x 1/8" Fillister-head screw
2	272103-00-4	Washer
3	261247-00-0	4-48 x 1/4" Fillister-head screw
4	285228-00-5	Cord clamp
5	220860-00-9	4-48 x 1/4" Flat-head screw
6	293399-00-0	Cord-clamp bracket
7	285229-00-1	Strap
8	302090-00-2	Indicator bracket (#2 pen)
9	331159-00-7	#2 Pen carriage (includes items 10, 11, 12 and 16)
10	302083-00-6	6-32 Thumb nut
11		6-40 x 1/8" Cone-point setscrew
12	302087-00-1	6-32 x 1/2" Pivot screw
13	302101-00-4	Filler cap
14	331162-00-8	#2 Pen (includes item 13)
15	285230-00-0	Indicator clamp
16	302084-00-2	6-32 x 3/8" Pivot screw
17	295872-00-4	Indicator (#2 pen, blue)
20	295871-00-8	Indicator (#1 pen, red)
21	302080-00-7	Indicator bracket (#1 pen)
22	245692-00-2	Washer
23	331158-00-0	#1 Pen carriage (includes items 10, 11, 12 and 16)
24	331161-00-1	#1 Pen (includes item 13)
25	293390-00-2	Indicator guide
30	218339-00-3	6-40 x 3/16" Fillister-head screw
31	285291-00-9	Pulley shaft for 3-, 7-, 12- and 24-second pen speeds
	302206-00-0	Pulley shaft for 1-second pen speed
32	264029-00-3	8-32 x 7/16" Fillister-head screw
33	292392-00-1	Cord-pulley bracket complete, left hand, for 3-, 7-, 12- and 24-second pen speeds (including items 31, 34, 35 and 36)
	298007-00-2	Pulley bracket only
	*282403-00-0	6-40 x 1/8" Flat-point setscrew
	303814-00-4	Cord-pulley bracket complete, left hand for 1-second pen speed (including items 31, 34 and 35)
	298007-00-2	Pulley bracket only
	*282403-00-0	6-40 x 1/8" Flat-point setscrew
34	228211-00-0	Spacer
35	292390-00-9	Pulley for 3-, 7-, 12- and 24-second pen speeds
	303811-00-5	Pulley for 1-second pen speed
36	279854-00-5	Retaining ring
37	293381-00-3	Left-hand support bracket
38	266539-00-9	10-32 x 3/8" Fillister-head screw
39	285256-00-9	Pen guide rod
40	293380-00-7	Pen support rod #2 pen
41	285271-00-8	Pen support rod #1 pen
42	301567-00-0	Bumper
43	247622-00-1	Washer
44	293382-00-0	Right-hand support bracket
45	292387-00-8	Cord-pulley bracket complete, right hand, for 24- 12- 7- and 3-second pen speeds (including items 31, 34, 35 and 36)
	298006-00-6	Pulley bracket only
	*282403-00-0	6-40 x 1/8" Flat-point setscrew
	303813-00-8	Cord-pulley bracket complete, right hand for 1-second pen speed (including items 31, 34 and 35)
	298006-00-6	Pulley bracket only
	*282403-00-0	6-40 x 1/8" Flat point setscrew
46	301568-00-6	Adjusting screw
47	302067-00-0	Bumper bracket
48	276302-00-1	Spacer
49	285268-00-7	Bearing
50	285269-00-3	Locknut
51	239770-00-5	6-40 x 1/4" Fillister-head screw
52	291089-00-3	6-40 x 1/4" Special-head screw
53	249767-00-7	Post
	295425-00-8	Washer
54	261682-00-8	Double-headed screw
55		Scale (order by model and serial number of instrument)
56	220903-00-0	6-40 Hexagon nut

*Not Shown

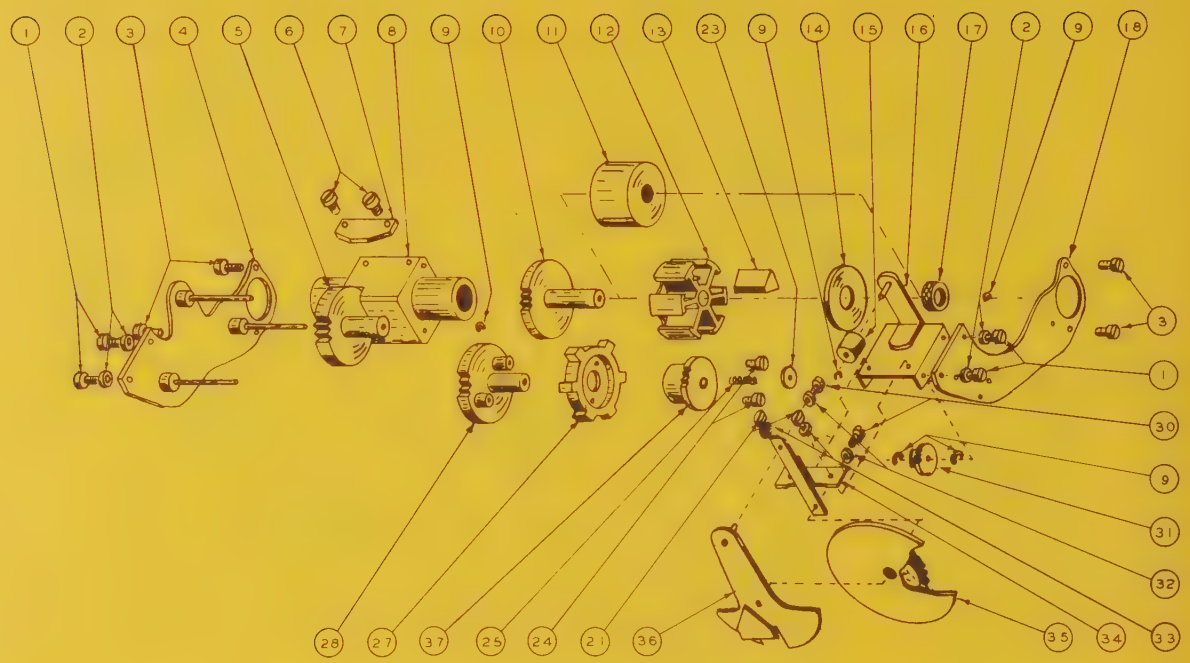


FIGURE 16. MULTIPLE-PRINTING MECHANISM

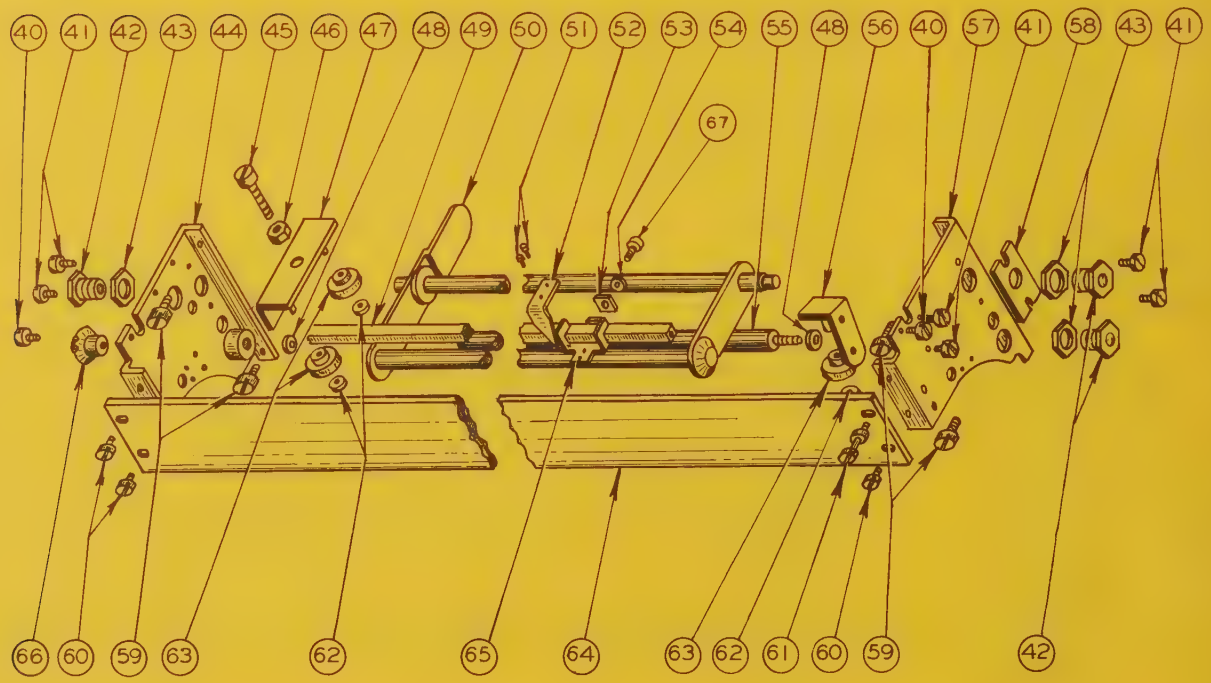


FIGURE 17. PRINTING MECHANISM SUPPORT FOR MULTIPLE-POINT RECORDER

KEY TO FIGURES 16. & 17.

ITEM	PART NO.	DESCRIPTION
1	237603-00-4	2-64 x 3/16" Fillister-head screw
2	268791-00-7	#2 Lockwasher
3	210626-00-3	4-48 x 1/8" Fillister-head screw
4	285263-00-5	Left-hand plate
5	286072-00-9	Gear (48T-48P)
6	230628-00-1	4-48 x 3/16" Fillister-head screw
7	285228-00-5	Cord clamp
8	285235-00-1	Frame
9	280607-00-8	Retaining ring (1/8" shaft)
10	288197-00-3	Gear (48T-48P)
11	294449-00-0	Container of 5 rolls for 1-color printing (purple)
12	268196-00-1	Felt-holder (6-segment)
	269626-00-0	Felt-holder (8-segment)
	294272-00-3	Felt-holder (12-segment) (Separate cap - part 294274-00-6)
13		INKING FELTS (CONTAINER OF 6)

	BLACK	RED	PURPLE	GREEN	BLUE	BROWN
6-segment	291000-00-2	291001-00-9	291002-00-5	291003-00-1	291004-00-8	291005-00-4
8-segment	291006-00-0	291007-00-7	291008-00-3	291009-00-0		
12-segment	294282-00-9	294283-00-5	294284-00-1	294400-00-1	294401-00-8	294402-00-4

14 DESIGNATION DISK

269545-00-0 - 2-point	269645-00-4 - 4-point
268199-00-0 - 3-point	268198-00-4 - 6-point

ITEM	PART NO.	DESCRIPTION
15	286070-00-6	Roller Complete
16	285293-00-1	Roller bracket complete
17	268182-00-0	Thumb nut
18	296762-00-8	Right-hand plate
21	265071-00-3	3-56 x 1/8" Fillister-head screw
23	223212-00-8	Washer
24	273927-00-0	2-64 x 7/32" Fillister-head screw
25	286066-00-9	Spring
27	287374-00-9	Type wheel (dots only) 2, 3, or 6-point
	287375-00-5	Type wheel (dots only) 4-point

TYPE WHEEL (DOTS AND NUMBERS)

268193-00-2 - 2-point	268195-00-5 - 6-point	287841-00-6 - 12-point	315866-00-4 - 24-point
268194-00-9 - 3-point	269636-00-5 - 8-point	289872-00-6 - 16-point	
269637-00-1 - 4-point	294433-00-7 - 10-point	294440-00-3 - 20-point	

ITEM	PART NO.	DESCRIPTION
28	311397-00-0	Gear and hub (48P-48T)
30	263800-00-8	1-72 Fillister-head screw
31	296760-00-5	Idler gear
32	242762-00-0	Washer
33	296752-00-2	Washer
	270694-00-5	Shakeproof washer
34	296758-00-0	Mounting bracket
35		Indexing disc

296798-00-2 - 2-point	296788-00-7 - 6-point	296779-00-8 - 12-point	296770-00-0 - 24-point
296794-00-7 - 3-point	296785-00-8 - 8-point	296776-00-9 - 16-point	
296791-00-8 - 4-point	296782-00-9 - 10-point	296773-00-0 - 20-point	

ITEM	PART NO.	DESCRIPTION
36	296768-00-6	Shield and pointer
37	296753-00-9	Idler drive gear
	282403-00-0	6-40 x 1/8" flat-point setscrew
40	239770-00-5	6-40 x 1/4" Fillister-head screw
41	218339-00-3	6-40 x 3/16" Fillister-head screw
42	285268-00-7	Bearing screw
43	285269-00-3	7/16"-27 Hexagon nut
44	285298-00-3	Left-hand support bracket
45	266546-00-5	10-32 x 1" Fillister-head screw
46	272055-00-0	10-32 Hexagon nut
47	288185-00-5	Control-index pulley complete (including items 62 & 63)
48	286048-00-0	Thrust washer
49	288188-00-4	Control-index support rod
50	286088-00-2	Depressor bar
51	262795-00-0	2-64 x 3/32" Hexagon-head screw
52	288189-00-0	Control index
53	288191-00-5	Cord clamp
54	276293-00-2	2-64 Thumb nut
55	286078-00-7	Spline shaft
56	288181-00-0	Control-index pulley complete (includes items 62 and 63)
57	285249-00-2	Right-hand support bracket
58	286091-00-3	Adjusting plate
59	266539-00-9	10-32 x 3/8" Fillister-head screw
60	291089-00-3	6-40 x 1/4" Special-head screw
61	261682-00-8	6-40 Double-headed screw
62	279854-00-5	Retaining ring (3/16" shaft)
63	276283-00-7	Pulley
64		Scale (order by model and serial number of instrument)
65	288190-00-9	Control-index bracket
66	244009-00-7	Miter gear
67	240018-00-1	2-64 x 1/4" Fillister-head screw

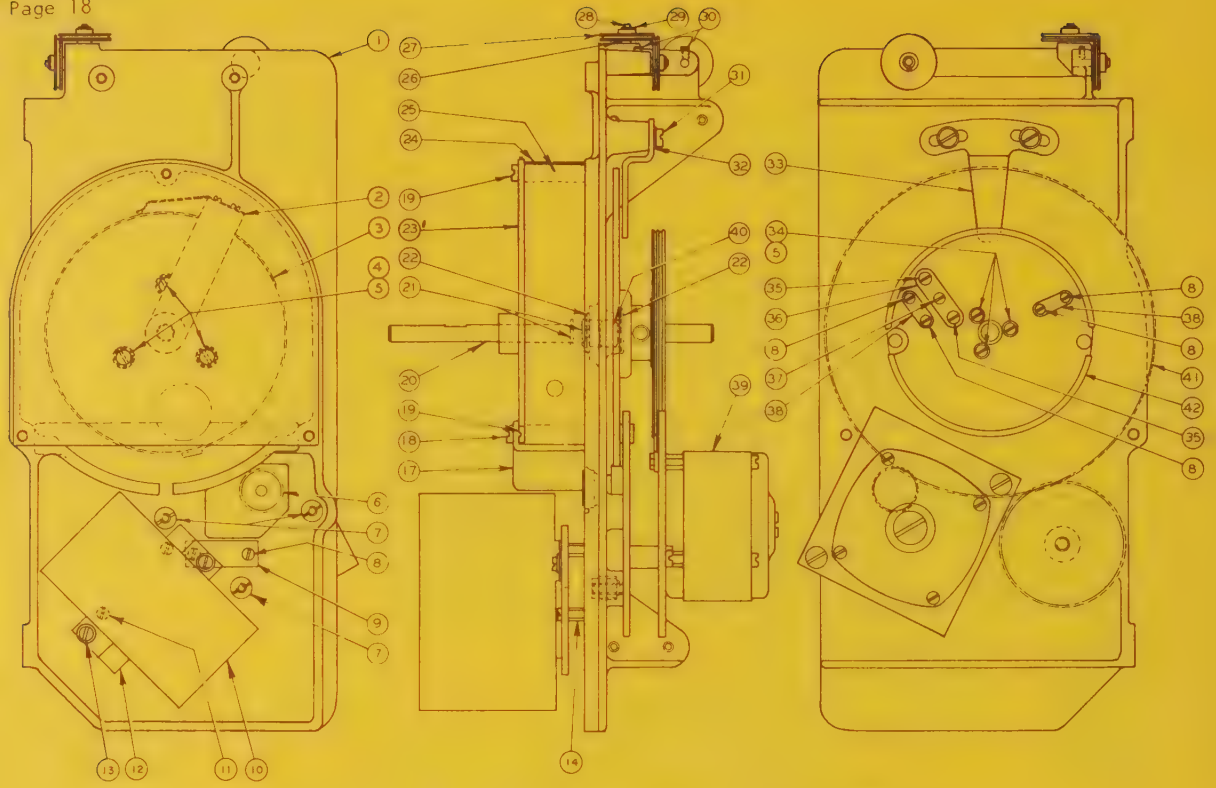


FIGURE 18. NO. 2 BALANCING MECHANISM FOR 2-PEN RECORDER

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	351007-00-8	Frame
2		Brush arm complete, specify model, range and serial no. of instrument
		Contact arm, specify model, range and serial no. of instrument
3		Slidewire (order by model and serial number of instrument)
5	243040-00-8	#6 Lockwasher
6		Motor pinion
	291930-00-0	For instruments with 24-second pen travel
	286036-00-2	For instruments with 7-second or 4.5 second pen travel
	291932-00-2	For instruments with 3-second or 1-second pen travel
	304988-00-6	For instruments with 0.4 second pen travel
7	286053-00-4	Motor-mounting nuts
8	239770-00-5	6-40 x 1/4" Fillister-head screw
9	289118-00-0	Cable strap
10	332767-00-0	Zener Reference Voltage source (Series L10 Amplifiers only)
11	220335-00-1	6-40 x 5/16" Flat-head screw
12	307046-00-1	Mounting plate
13	306254-00-0	8-32 x 1/4" Fillister-head screw
14	249767-00-7	Post
15	293658-00-5	Index
16	268345-00-7	6-40 x 3/16" Special-head screw
17	302065-00-8	Cover
18	240066-00-6	8-32 x 1/4" Fillister-head screw
19	265984-00-9	10-32 x 1 1/2" Fillister-head screw
20	293034-00-1	Shaft
21	289117-00-3	Shaft retaining ring
22	224804-00-6	Thrust washer
23	302063-00-5	Slidewire back cover
24	289865-00-0	Slidewire cover
25	289112-00-1	Post for slidewire cover
26	228211-00-0	Washer
27	292390-00-9	Pulley for instruments with 3-, 4.5-, 7- and 24-second pen travel
	303811-00-5	Pulley for instruments with 0.4- and 1 second pen travel
28	285291-00-9	Pulley shaft
29	280607-00-8	Retaining ring
30	282403-00-0	6-40 x 1/8" Flat-point setscrew
31	267029-00-4	10-32 x 5/16" Fillister-head screw
32	210075-00-7	Washer

(continued on page 19)

KEY TO FIGURE 18. CONTINUED

BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENTS WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
33	285272-00-4	Gear stop for instruments with 3-, 4.5-, 7- and 24-second pen travel
	293320-00-4	Gear stop for instruments with 0.4 and 1-second pen travel
34	231427-00-0	6-40 x 5/16" Fillister-head screw
35	220021-00-7	6-40 x 1/4" Flat-head screw
36	276276-00-0	Tension-shaft clamp
37	276273-00-1	Tension-shaft
38	285319-00-0	Cord clamp
39		Balancing motor (specify model & serial number of instrumen
40	286043-00-9	Needle bearing
41	302102-00-0	Bull gear complete for 3-, 4.5-, 7- and 24-second pen trave (includes setscrew and items 5, 8, 34 thru 38 and 42)
	286052-00-8	Bull gear and hub only for 3-, 4.5- 7- and 24-second pen travel
	331556-00-6	Bull gear complete for 1- and 0.4 second pen travel (includes setscrew and items 5, 8, 34 thru 38 and 42)
	293360-00-6	Bull gear and hub only for 1- and 0.4 second pen travel
	289049-00-8	5/16-18 x 5/16" flat point setscrew
42	302104-00-3	Sheave
	312551-02-9	Drive cord #2 pen

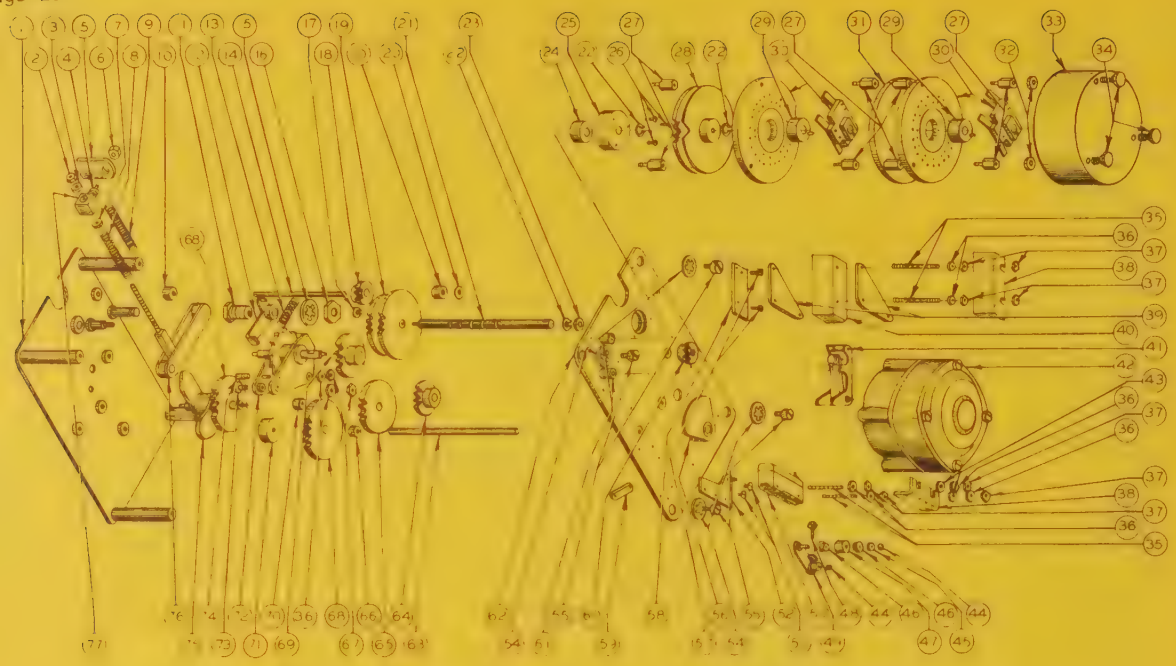


FIGURE 19. MULTIPLE-SWITCHING ASSEMBLY FOR MULTIPLE-POINT RECORDER

TEM	PART NO.	DESCRIPTION
	341516-00-7	Multiple switching mechanism for 0.4 sec. Dynamaster only.
	298068-00-1	Dynamaster multiple switching mechanism complete for all instruments except those with battery standardizing, less motor & switch deck. Specify model & serial number of instrument.
	298069-00-8	Dynamaster multiple switching mechanism complete for all instruments with battery standardizing, less motor & switching deck. Specify model & serial number of instrument.
1	288004-00-0	Front plate complete
2	282647-00-7	6-40 Self-locking nut
3	288083-00-8	Yoke washer
4	288081-00-5	Depressor yoke
5	286088-00-2	Depressor bar
6	289653-00-2	Depressor-yoke nut
7	288082-00-1	Spring collar
8	288080-00-9	Printing pressure spring
9	270610-00-6	Printing-lever spring
0	253889-00-6	Collar, including setscrew
	282403-00-0	6-40 x 1/8" Flat-point setscrew for item 10
1	295557-00-1	Latch-lever adjustment nut (see item 12)
2	295556-00-5	Latch-lever complete, includes items 11, 15 and 16
3	288032-00-4	Latch-lever spring
4	288092-00-7	Miter-gear shaft
5	240262-00-0	Lockwasher
6	240278-00-3	5/16"-32 x 1/8" Hexagon nut
7	279854-00-5	Tru-Arc retaining ring
8	288056-00-0	Pinion complete including setscrew
	282403-00-0	6-40 x 1/8" Flat-point setscrew for item 18
9		Gear including setscrew
	305395-00-9	(50T x 84T - 48P) for 2-, 3-, or 6-point instrument
	305396-00-5	(60T x 84T - 48P) for 4- or 8-point instrument
	305397-00-1	(70T x 84T - 48P) for 10-point instrument
	305398-00-8	(75T x 84T - 48P) for 12-point instrument
	305399-00-4	(72T - 40P x 84T - 48P) for 16-point instrument
	305400-00-2	(95T x 84T - 48P) for 20-point instrument
	305401-00-9	(100T x 84T - 48P) for 24-point instrument
	282413-00-6	10-32 x 3/16" Flat-point setscrew for item 19
20	286048-00-0	Thrust washer
21	288084-00-4	Multiple-switching shaft for 560 Dynamaster
	296842-00-1	Multiple-switching shaft for Dynamaster Recorder deep case only
22	291015-00-0	Retaining ring
23	261381-00-8	Thrust washer
24	288085-00-0	Ball bearing
25	288086-00-7	Bearing housing

KEY TO FIGURE 19. CONTINUED

ITEM	PART NO.	DESCRIPTION
26	289037-00-0	4-48 x 3/8" Flat-head screw
27	288068-00-9	Post 7/16" long, not including threaded end
	289375-00-2	Post 9/16" long, not including threaded end
	288070-00-3	Post 5/8" long, not including threaded end
	288144-00-7	Post 1 5/32" long, not including threaded end
28	289000-00-9	Gear (120T-48P) and cam assembly
29	296132-00-4	Switch-blade collar
30	298011-00-0	Switch plate and contact arm for 2-3-4-6-8-12-24 point multiple
	298013-00-2	Contact arm only for above
	298014-00-9	Switch plate and contact arm for 10 & 20 pt. multiple
	298016-00-1	Contact arm only for 10 & 20 pt. multiple
	298017-00-8	Switch plate and contact arm for 16 pt. multiple
	298019-00-0	Contact arm only for 16 pt. multiple
31	288067-00-2	Separating plate
32	282381-00-7	Washer
33	288071-00-0	Switch cover for a-c Bridge type instruments
	288145-00-3	Switch cover for d-c Potentiometer type instruments
34	255785-00-3	10-32 x 3/8" Thumb screw
35	286086-00-0	Switch stud
36	279008-00-7	#6 Lockwasher
37	220903-00-0	#6-40 Hex. nut
38	289863-00-7	Switch cover
39	279634-00-5	Cam-follower plate
40	254866-00-0	Snap-action switch
41	279622-00-7	Cam follower complete
	*279621-00-0	Spacer }
	*288173-00-7	Cam-follower shaft } used with item 41
	*280607-00-8	Retaining ring }
42	288060-00-8	Motor, 120 volt, 50-60 cycle for 8-, 15- or 30-second print interval
	292128-00-2	Motor, 120 volt, 50-60 cycle for 1.0-, 1.9-, 2.3-, 3.9- or 4.5-sec. print inter
	296738-00-0	Motor, 120 volt, 50-60 cycle for 60-second print interval
43	221252-00-2	Washer
44	280607-00-8	Retaining ring (see item 49)
45	215536-00-2	Washer (see item 49)
46	270903-00-3	Oil-less bushing (see item 49)
47	298044-00-5	Cam roller (see item 49)
	298043-00-9	Cam roller complete, includes items 46 and 47
48	279626-00-2	6-32 x 7/16" Hex-head screw (see item 49)
49	298040-00-0	Cam-follower arm complete, includes items 44, 45, 46, 47 and 48 (see item 52)
50	298035-00-6	Snap-action switch
51	220335-00-1	6-40 x 5/16" Flat-head screw
52	298036-00-2	Cam follower complete (includes item 49)
54	235638-00-5	#10 Lockwasher
55	266537-00-6	10-32 x 1/4" Fillister-head screw
56	298070-00-6	Cam complete
57	221407-00-6	6-40 x 1/2" Flat-head screw
58	294890-00-9	Switch mounting plate
59	298053-00-4	Mounting strap
60	286018-00-4	Pinion (30T-48P) not including setscrew
	*282403-00-0	6-40 x 1/8" Flat-point setscrew for item 60
61	295911-00-0	Spacer
62	288001-00-1	Back plate complete
63	298072-00-9	Cam shaft
64		Motor pinion
	292129-00-9	(46T-48P) for 8-second print interval
	294261-00-1	(22T-48P) for 3.9-or 60-second print interval
	288061-00-4	(19T-48P) for 4.6- or 30-second print interval
	289150-00-0	(36T-48P) for 2.3- or 15-second print interval
	294460-00-4	(37T-48P) for 1.9-second print interval
	298000-00-8	(63T-48P) for 1.0-second print interval
	282413-00-6	10-32 x 3/16" Flat-point setscrew for item 64
65		Gear, including setscrew
	294263-00-4	(86T-48P) for 3.9- or 60-second print interval
	288014-00-6	(89T-48P) for 2.3- or 4.6-second print interval
	292131-00-3	(62T-48P) for 8-second print interval
	294462-00-7	(71T-48P) for 1.9-second print interval
	294464-00-0	(62T-48P) for 1.0-second print interval
	282413-00-6	10-32 x 3/16" Flat-point setscrew for item 65
66	253172-00-4	Collar, not including setscrew
	*282403-00-0	6-40 x 1/8" Flat-point setscrew
67	200772-00-7	6-40 Hex. nut
68	294515-00-3	Gear complete (74T-48P)

*Not

KEY TO FIGURE 19. CONTINUED

ITEM	PART NO.	DESCRIPTION
69		Ratchet-shaft gear
	288037-00-6	(100T-48P) for 2-, 3- or 6-point instrument
	288072-00-6	(90T-48P) for 4- or 8-point instrument
	294427-00-7	(84T-48P) for 10-point instrument
	286076-00-4	(75T-48P) for 12-point instrument
	289874-00-9	(54T-40P) for 16-point instrument
	294435-00-0	(57T-48P) for 20-point instrument
	296116-00-9	(50T-48P) for 24-point instrument
	282413-00-6	10-32 x 3/16" Flat-point setscrew for item 69
70	288034-00-7	Cam roll
71	298031-00-0	Ball bearing
72	298027-00-3	Ratchet assembly complete, includes items 36, 67, 70, 71, 73 & 74
73	298032-00-7	Shoulder screw
74	298093-00-6	Stud
75	298073-00-5	Cam shaft assembly complete
76	288042-00-0	Printing lever complete
77	295913-00-2	Sleeve

	MOTOR (ITEM 42 FIG. 19)	GEAR			
PRINT INTERVAL	50-60 CYCLE	ITEM NUMBER	PITCH	NUMBER OF TEETH	PART NUMBER
1.0 sec.	292128-00-2	64 65	48 48	63 62	298000-00-8 294464-00-0
1.9 sec.	292128-00-2	64 65	48 48	37 71	294460-00-4 294462-00-7
2.3 sec.	292128-00-2	64 65	48 48	36 89	289150-00-0 288014-00-6
3.9 sec.	292128-00-2	64 65	48 48	22 86	294261-00-1 294263-00-4
4.5 sec.	292128-00-2	64 65	48 48	19 89	288061-00-4 288014-00-6
8 sec.	288060-00-8	64 65	48 48	46 62	292129-00-9 292131-00-3
15 sec.	288060-00-8	64 65	48 48	36 89	289150-00-0 288014-00-6
30 sec.	288060-00-8	64 65	48 48	19 89	288061-00-4 288014-00-6
60 sec.	296738-00-0	64 65	48 48	22 86	294261-00-1 294263-00-4

FIGURE 20. TABLE OF MOTORS AND CHANGE GEARS FOR MULTIPLE-SWITCHING ASSEMBLY

LOW SPEED GEAR TRAIN 120 V. 60 Cycle				HIGH SPEED GEAR TRAIN 120 V. 60 Cycle			Gear Position	Pitch	No. of Teeth	Part Number	Identification
2 RPM TELECHRON	4 RPM TELECHRON	10 RPM HOLTZER CABOT	60 RPM HOLTZER CABOT	4 RPM HOLTZER CABOT	10 RPM HOLTZER CABOT	60 RPM HOLTZER CABOT					
286058-00-6	292110-00-6	288060-00-8	253680-00-0	296738-00-0	288060-00-8	292128-00-2					
Chart Speed (inches/Hour)						Chart Speed (In./Min.)					
3/4	1 1/2	3 3/4	22 1/2	60	150	15	1 2	40 40	16 64	292105-00-2 292103-00-0	C H
1	2	5	30	80	200	20	1 2	48 48	24 72	279225-00-8 279223-00-5	J N
1 1/2	3	7 1/2	45	120	300	30	1 2	48 48	32 64	279218-00-1 279222-00-9	K M
2	4	10	60	160	400	40	1 2	40 40	32 48	279227-00-0 279221-00-2	E F
3	6	15	90	240	600	60	1 2	48 48	48 48	279224-00-1 279224-00-1	L L
4 1/2	9	22 1/2	135	360	900	90	1 2	40 40	48 32	279221-00-2 279227-00-0	F E
5	10	25	150	400	1000	100	1 2	40 40	50 30	294210-00-8 294212-00-0	G D
6	12	30	180	480	1200	120	1 2	48 48	64 32	279222-00-9 279218-00-1	M K
9	18	45	270	720	1800	180	1 2	48 48	72 24	279223-00-5 279225-00-8	N J
10	20	50	300	800	2000	200	1 2	32 32	50 15	294214-00-3 294216-00-6	B A
12	24	60	360	960	2400	240	1 2	40 40	64 16	292103-00-0 292105-00-2	H C

FIGURE 21. TABLE OF MOTORS AND CHANGE GEARS FOR SINGLE-SPEED CHART DRIVE

FAST SPEED GEAR TRAIN					CHANGE GEARS	
MOTOR SPEEDS (120 V. 60 Cy. only)					NUMBER OF TEETH	PART NUMBER
1 RPM	2 RPM	4 RPM	10 RPM	60 RPM		
331277-00-0	331276-00-3	296738-00-0 255327-00-5 (a)	288060-00-8	331279-00-2 253680-00-0 (a)		
CHART SPEED (inches per minute)				CHART SPEED (inches per second)		
1/4	1/2	1	2-1/2	1/4 (a)	16 64	302531-00-9 302529-00-4
1/3	2/3	1-1/3	3-1/3	1/3 (a)	24 72	301539-00-6 301536-00-7
1/2	1	2	5	1/2 (a)	32 64	301540-00-4 301544-00-0
2/3	1-1/3	2-2/3	6-2/3	2/3 (a)	32 48	302527-00-1 302526-00-5
1	2	4	10	1 (a)	48 48	301542-00-7 301542-00-7
1-1/2	3	6	15	1-1/2 (b)	48 32	302526-00-5 302527-00-1
2	4	8	20	2 (b)	64 32	301544-00-0 301540-00-4
3	6	12	30	3 (b)	72 24	301536-00-7 301539-00-6
4	8	16	40	4 (b)	64 16	302529-00-4 302531-00-9

(a) Used for two-pen Dynamasters, and with only the five speeds indicated.
(b) May run 1% slow.

FIGURE 22. CHART SPEEDS & CHANGE GEARS FOR WIDE-STRIP DYNAMASTERS WITH 2-SPEED ATTACHMENT T84. MOTORS ARE HOLTZER-CABOT 120 V. 60 CYCLE.

ITEMS NOT SHOWN

PART NO.	DESCRIPTION
342629-00-0	Power Pack for d-c resistance recorder
	AUTOMATIC PEN LIFTER (Attachment T6)
293336-00-8	Rotary solenoid
282096-00-0	Spring
334806-00-3	Rectifier
	PEN ACCESSORIES
308253-00-0	Ball Point pen (Red) } Screw in Type
308254-00-7	Ball Point pen (Blue) } Screw in Type
308255-00-3	Ball Point pen (Green) } Screw in Type
308256-00-0	Ball Point pen (Black) } Screw in Type
382476-04-2	2-ounce bottle of red ink
382476-05-0	2-ounce bottle of blue ink
382476-22-0	2-ounce bottle of black ink
382476-06-9	2-ounce bottle of green ink
382476-23-9	2-ounce bottle of purple ink
272693-00-0	Pen filler
303801-00-0	Pen starter
232900-00-0	Pen cleaner
	MISCELLANEOUS PARTS
298130-00-9	1/4-ounce bottle of Cramolin
305700-00-6	1-pint Bristol cleaning fluid (metal container)
291982-00-0	Bristol Motor Oil (plastic container)
289030-00-5	Drive cord

ACCO BRISTOL DIVISION
WATERBURY, CONNECTICUT 06720

PARTS LIST
May 1968

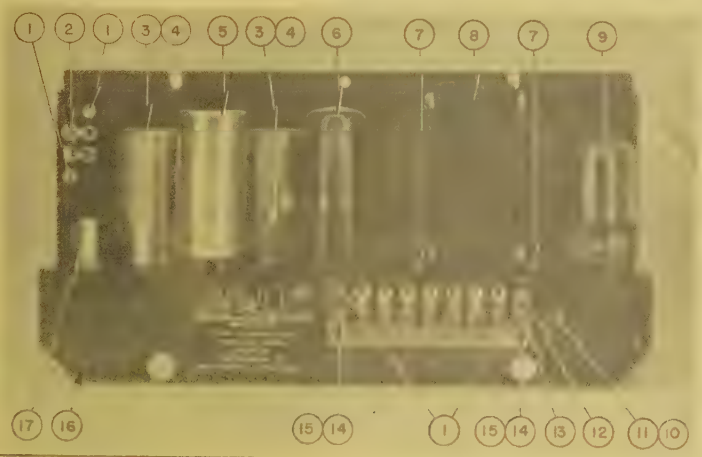
P12077

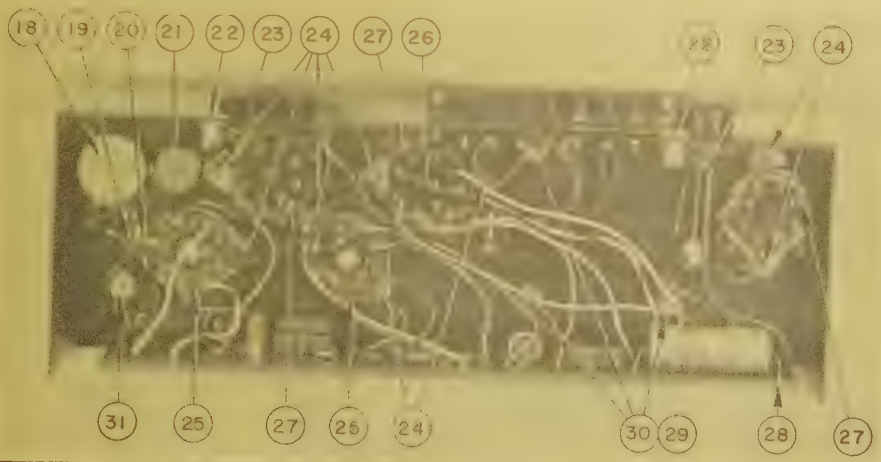
EDP 910120-29-3

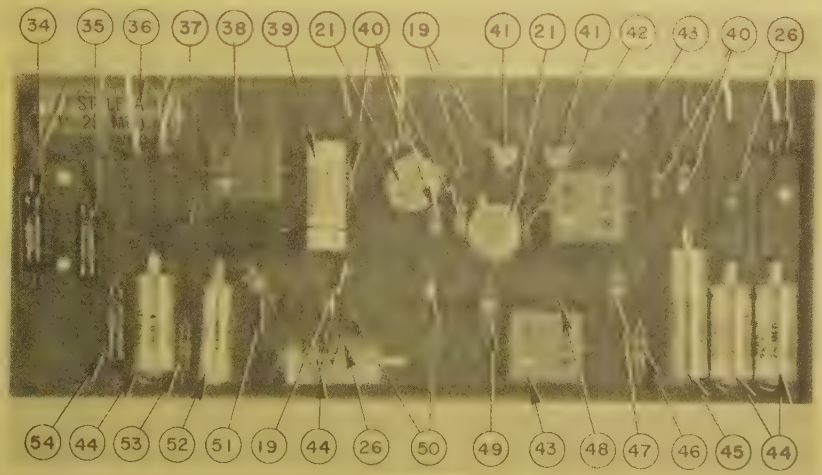
PARTS LIST P12077

SERIES C-1, C-3, C-4, D, D-2, & D-3 AMPLIFIERS

USED IN SERIES 560, 565, & 570 DYNAMASTER® RECORDERS







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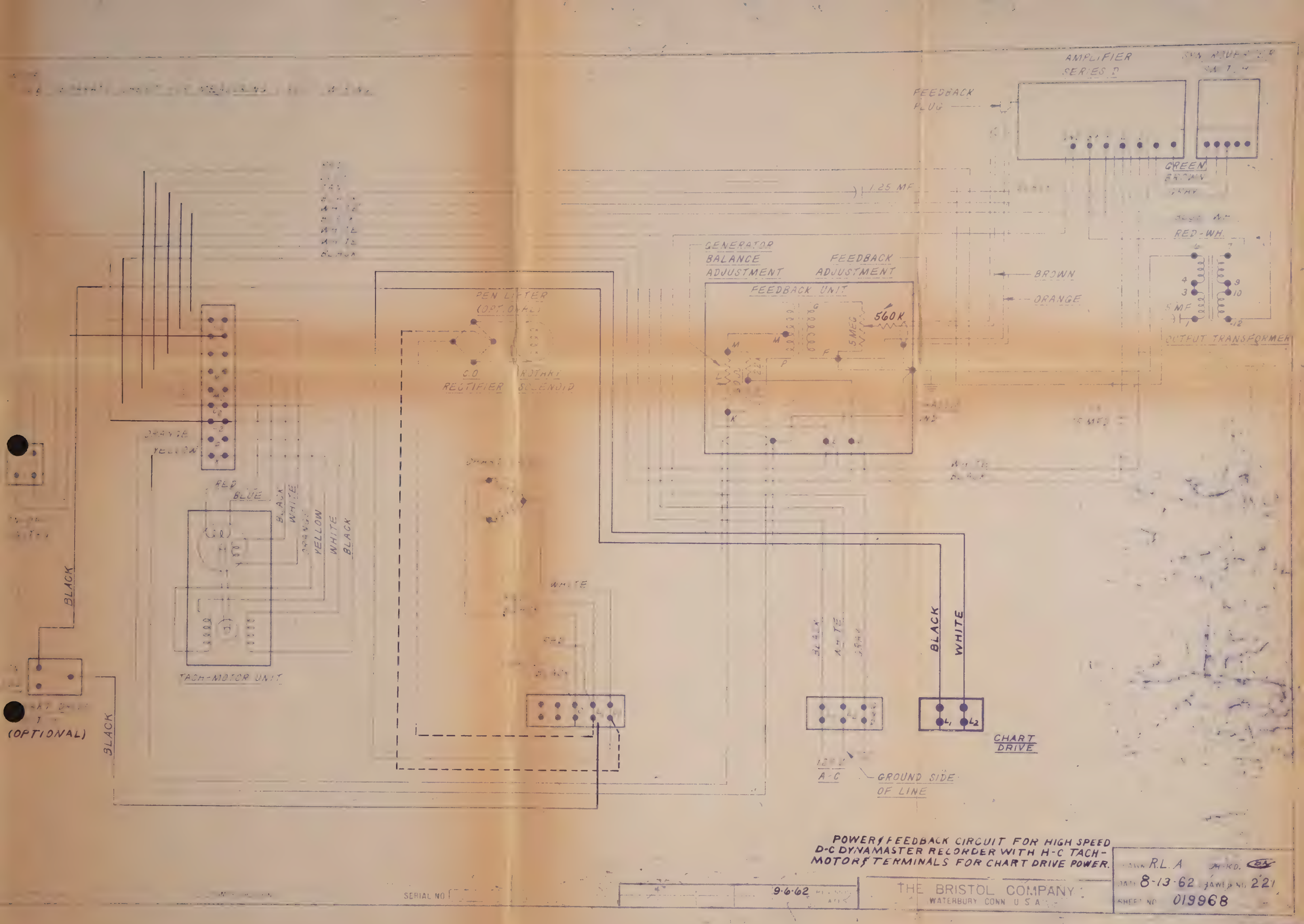
BE SURE TO STATE MODEL AND SERIAL NUMBER OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NUMBER	DESCRIPTION
	297600-00-1	Series C-1 Amplifier complete
	341096-00-8	Series D Amplifier complete
1	286100-00-2	6-32 x 1/2" Self-Tapping screw
2	283987-00-6	Terminal block (2-point)
3	291040-00-4	Tube shield
4	290596-00-9	7F7 Tube
5	283974-00-1	Capacitor
6	283972-00-9	6V6 - GT Tube for series C-1 amplifier
	302236-00-7	5881 Tube for series D amplifier
7	240066-00-6	8-32 x 1/4" Fillister-head screw
8	290582-00-8	Transformer for series C-1 amplifier
	331215-00-4	Transformer for series D amplifier
NOT SHOWN	302240-00-4	Transformer mounting plate for series D amplifier
NOT SHOWN	302238-00-0	8-32 x 5/8" Flat-head screw for above plate
NOT SHOWN	302239-00-6	Spacer for above plate
9	290595-00-2	6X5 - GT Tube (for series C-1 amplifier)
	304409-00-6	6AX5 - GT Tube (for series D amplifier)
10	284716-00-6	Fuse holder
11	264283-00-7	Fuse (1/8 amp. Littlefuse)
12	290594-00-6	Terminal block (7-point)
NOT SHOWN	290636-00-0	Shield over 7-point terminal block
13	291946-00-3	Marking strip (7-point)
14	291136-00-1	6-32 x 3/4" Binding-head screw
15	245081-00-3	Collar
16	341083-00-3	Chassis complete for series C-1 amplifier
	341097-00-4	Chassis complete for series D amplifier
17	284549-00-2	Potentiometer shaft cap
18	310979-00-5	Potentiometer (1 megohm ±10% tolerance)
19	283980-00-1	Resistor (1 megohm, 1/2 watt, ±10% tolerance)
20	283981-00-8	Resistor (4.7 megohm, 1/2 watt, ±10% tolerance)
21	302182-00-4	Capacitor (ceramic) (.075 microfarad, 400 volt, ±5% tolerance)
22	289121-00-0	Dzus fastener
23	289122-00-7	Washer
24	292359-00-4	Eyelet for mounting tube sockets
25	290593-00-0	Loctal socket
26	272226-00-9	Resistor (10,000 ohms, 1/2 watt ±10% tolerance)
27	271708-00-0	Octal socket
28	297632-00-0	Printed circuit assembly complete for series C-1 amplifier (includes items 19, 21 & 34 thru 54)
	331214-00-8	Printed circuit assembly complete for series D amplifier includes items 19, 21, 34 thru 50 and 52 thru 54
29	235639-00-1	Lockwasher
30	226966-00-3	8-32 Hex nut
31	297630-00-8	Capacitor (ceramic) (470 micro microfarads ±10% tolerance)
34	297617-00-1	Resistor (250 ohm, 5 watt ±5% tolerance)
35	297619-00-4	Resistor (10,000 ohm, 5 watt, ±5% tolerance)
36	297627-00-7	Capacitor (paper) (.25 microfarad, 600 volt, ±20% tolerance)
37	297620-00-2	Resistor (22,000 ohm, 10 watt ±5% tolerance)
38	297628-00-3	Capacitor (mica) (.003 microfarad, 500 volt, ±2% tolerance) for C-1 only.
39	297626-00-0	Capacitor (paper) (.022 microfarad, 600 volts ±10% tolerance)
40	283979-00-3	Resistor (470,000 ohm, 1/2 watt ±10% tolerance)
41	297629-00-0	Capacitor (ceramic) (250 micro microfarad, 1,000 volt, ±10% tolerance)
42	297684-00-0	Resistor (240,000 ohm, 1/2 watt ±1% tolerance)
43	290592-00-3	Capacitor (mica) (.0062 microfarad, 500 volt, ±5% tolerance)
44	297625-00-4	Capacitor (electrolytic) (25 microfarad, 50 volt -10% +150% tolerance)
	307053-00-8	Capacitor (electrolytic) (50 microfarad, 50 volt -10% +150% tolerance) ("D" amplifiers only)
45	297624-00-8	Capacitor (electrolytic) (12 microfarad, 250 volt -10% +150% tolerance)
46		Calibrating Resistor
47	297683-00-4	Resistor (75,000 ohm, 1/2 watt ±1% tolerance) for C-1 amplifier
	289085-00-4	Resistor (68,000 ohm, 1 watt ±10% tolerance) for D amplifier
48	297685-00-7	Resistor (300,000 ohm, 1/2 watt ±1% tolerance)
49		Calibrating resistor (as required when parallel "T" is tuned)
50	287018-00-8	Resistor (100,000 ohm, 1 watt ±10% tolerance)
51	297622-00-5	Resistor (680,000 ohms, 1 watt ±5% tolerance) for C-1 amplifier only
52	297623-00-1	Capacitor (electrolytic) (1 microfarad, 50 volt -10% +150% tolerance) for C-1
	297625-00-4	Capacitor (electrolytic) (1 microfarad, 50 volt -10% +150% tolerance) for D
53	297621-00-9	Resistor (10,000 ohm, 1 watt, ±5% tolerance)
54	297618-00-8	Resistor (1,000 ohm, 5 watt, ±5% tolerance) for series C-1
	297617-00-1	Resistor (250 ohm, 5 watt, ±5% tolerance) for series D
		NOT SHOWN
	277982-00-6	6-32 x 3/16" Binding-head screw for mounting printed circuit board to chassis

PART NUMBER	DESCRIPTION
341551-00-7	Series C-3 Amplifier complete
	Same as C-1 amplifier except for the following additions.
283980-00-1	Resistor 1.0 megohm 1/2 watt
303636-00-9	Socket
294585-00-1	Decalcomania
341646-00-8	Series C-4 Amplifier (50 cycle) complete
	Same as C-1 amplifier except for the following changes. Item 43 is changed to 293960-00-3
293960-00-3	.0075 microfarad capacitor
	Add to basic C-1 amplifier
302812-00-8	Resistor 390,000 ohm
294585-00-1	Nameplate
341552-00-3	Series D-2 Amplifier complete
	Same as D amplifier except for the following additions.
283980-00-1	Resistor 1.0 megohm 1/2 watt
303636-00-9	Socket
294585-00-1	Decalcomania
341650-00-5	Series D-3 Amplifier complete
	Same as D amplifier except for the following changes. Item 43 is changed to 293960-00-3
293960-00-3	.0075 microfarad capacitor
	Item 21 is changed to 302182-00-4
302182-00-4	.075 microfarad capacitor
	Add to basic D amplifier
294585-00-1	Nameplate
378624-01-6	Series C-6 Amplifier (50 cycle) complete
	Same as C-4 except for the following additions
293980-00-3	Resistor 1.0 megohm 1/2 watt
303636-00-9	Socket
294585-00-1	Decalcomania



POWER & FEEDBACK CIRCUIT FOR HIGH SPEED D-C DYNAMASTER RECORDER WITH H-C TACH-MOTOR & TERMINALS FOR CHART DRIVE POWER.

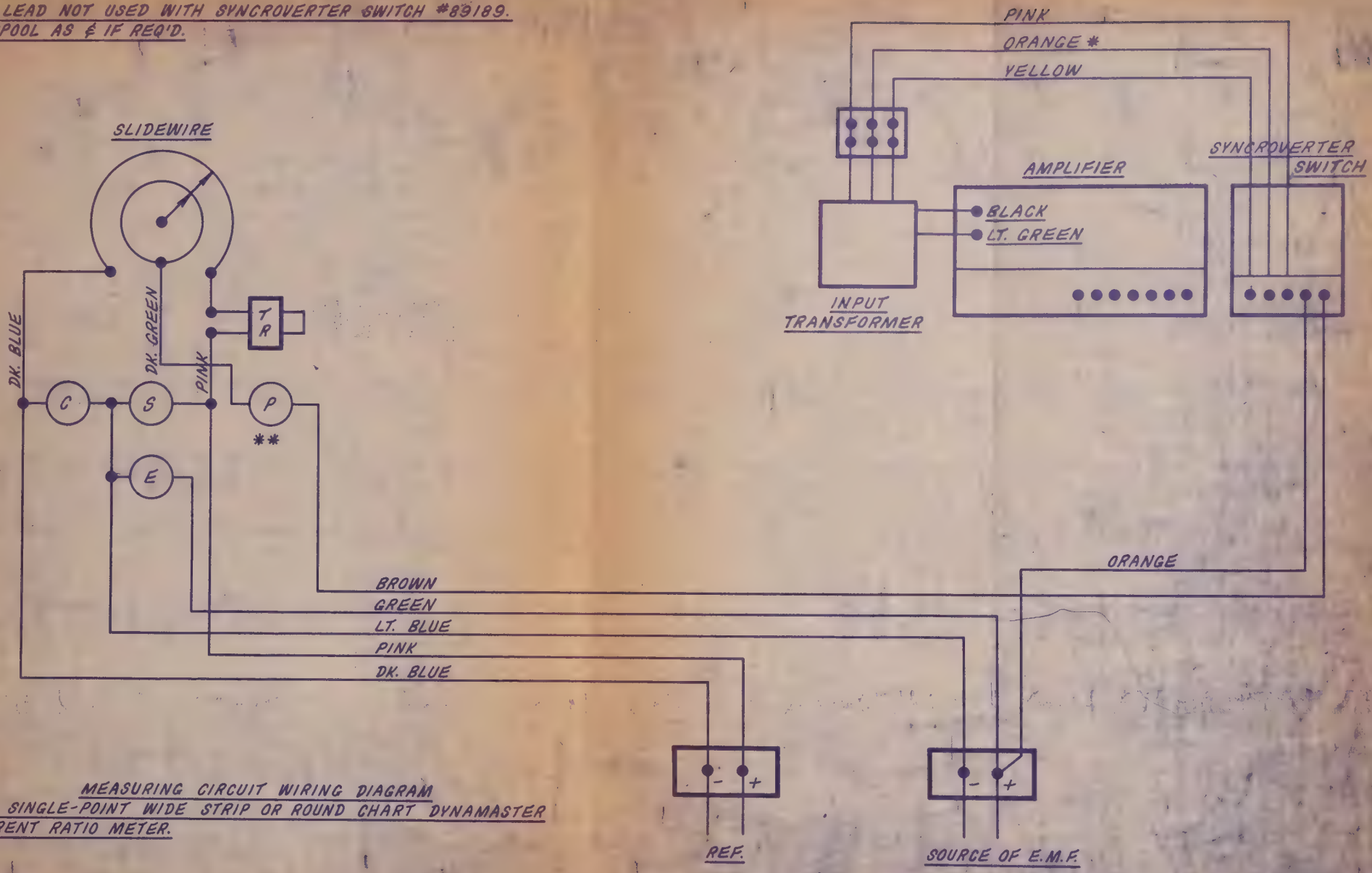
DRAWN R.L.A CHKD.
DATE 8-13-62 DRAWING NO. 221
SHEET NO 019968

THE BRISTOL COMPANY
WATERBURY CONN U S A

SERIAL NO

9-6-62

* THIS LEAD NOT USED WITH SYNCROVERTER SWITCH #83189.
** "P" SPOOL AS ℄ IF REQ'D.

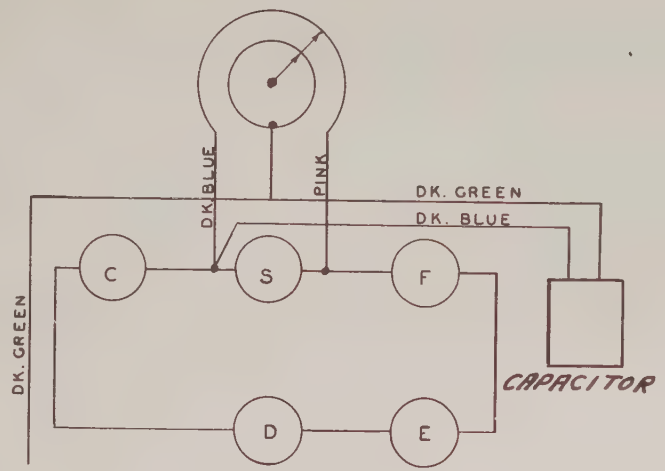


MEASURING CIRCUIT WIRING DIAGRAM
FOR SINGLE-POINT WIDE STRIP OR ROUND CHART DYNAMASTER CURRENT RATIO METER.

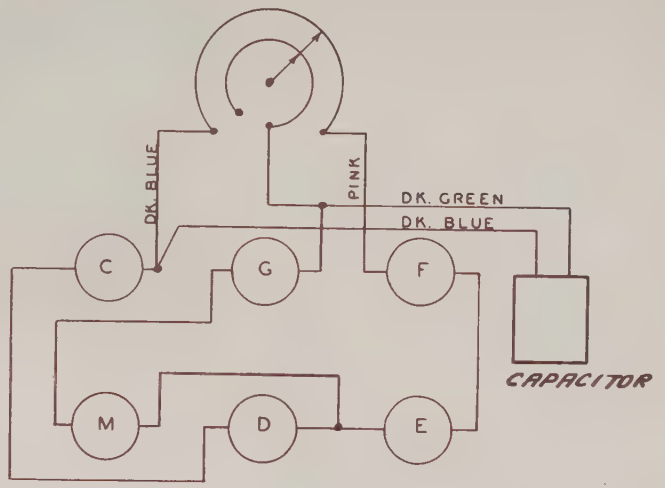
THE BRISTOL COMPANY
Waterbury

B.F.H. 6-21-62
Con
122
NO. 013653-A

TYPICAL STANDARD BRIDGE



TYPICAL DIVIDER BRIDGE



AUXILIARY WIRING DIAGRAM
SHOWING ANTI-BOUNCE CAPACITOR CONNECTIONS FOR STANDARD AND DIVIDER BRIDGES.

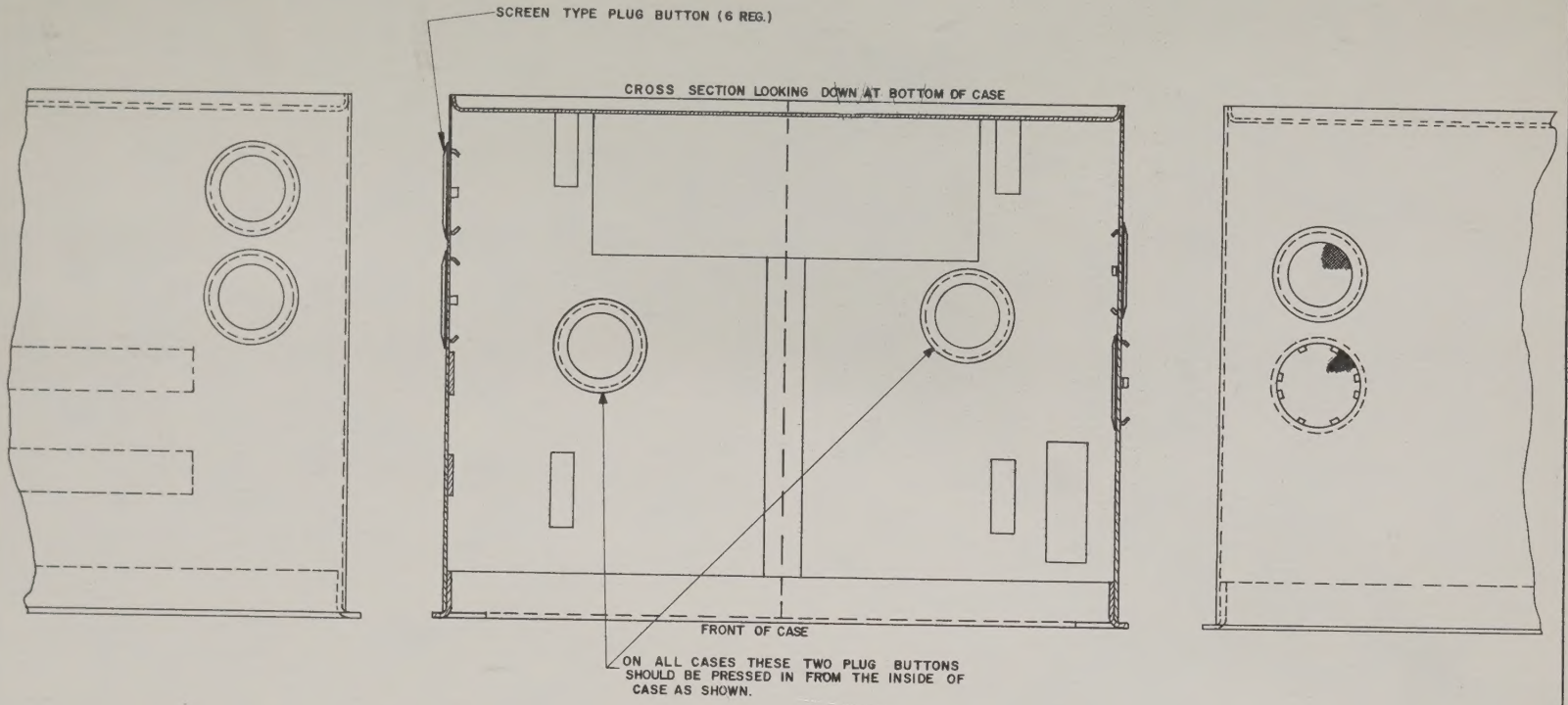
REDRAWN 12-4-58 H.I.S.

THE BRISTOL COMPANY
WATERBURY CONN. U. S. A.
DRAWN F. R. TRACED
DATE 10-30-55 DRAWER NO 122
SHEET NO 015058

B. CO ORDER NO
CUSTOMER ORDER NO
SERIAL NO.

4-17-59 REVISION DATES

NOTE:
THE PLUG BUTTONS THAT ARE MOUNTED ON THE SIDES OF THE CASE ARE SHOWN MOUNTED TWO WAYS.
FOR WALL MOUNTED CASES PRESS IN FROM OUTSIDE OF CASE.
FOR RACK OR PANEL MOUNTED CASES PRESS IN FROM INSIDE OF CASE


SCREEN TYPE PLUG BUTTON (6 REQ.)
CROSS SECTION LOOKING DOWN AT BOTTOM OF CASE
FRONT OF CASE
ON ALL CASES THESE TWO PLUG BUTTONS SHOULD BE PRESSED IN FROM THE INSIDE OF CASE AS SHOWN.

NOTE:- ALL PLUG BUTTONS SHOULD BE MOUNTED BY CUSTOMER AFTER CASE IS INSTALLED.

LTR.	REVISION	DATE	S.C.R.
		7-26-65	

ITEM	QUAN.	PART	NAME OR MATERIAL
			TOOLS
			PURCH. SPEC.

DO NOT SCALE THIS PRINT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE AFTER PLATING
EDGES AND CORNERS .005" TO .010" NOM. RAD.
TOLERANCES-FRACTIONS ± 1/64" DECIMALS ± .01
ANGLES ± 1°

INSTALLATION OF PLUG BUTTONS FOR VENTED DYNAMASTER CASES.

DRN. H.R.S.
TRC. J.A.D.
SPEC.
DATE 11-25-60
SHT. 1 OF 1

THE BRISTOL COMPANY
WATERBURY 20, CONN. U.S.A.

SIZE
NO 0 1 8 6 7 3
221

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